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Energy Research Abstracts

Abstracts 29613-33112

Office of Scientific & Technical Information
UNITED STATES DEPARTMENT OF ENERGY

CURRENT AWARENESS PUBLICATIONS ON ENERGY

To provide complete coverage of literature related to major Department programs, announcement publications that are comprehensive in their coverage of certain energy fields are issued regularly. All information in these publications, plus additional backup information, is included in the Energy Data Base of the Office of Scientific and Technical Information; all references are also available for machine searching via the on-line retrieval system, DOE/RECON, and the commercial on-line retrieval systems. Descriptions of these current awareness publications, which are supported either directly or indirectly by the DOE, appear below. Department of Energy components may receive the listed publications free from the Office of Scientific and Technical Information, U. S. Department of Energy, P. O. Box 62, Oak Ridge, TN 37831. Telephone (615) 576-1301; FTS 626-1301.

PUBLICATIONS OF THE OFFICE OF SCIENTIFIC AND TECHNICAL INFORMATION

Energy Abstracts for Policy Analysis (EAPA)
A monthly abstract journal devoted to the analysis of energy research, conservation, and policy. Scope and coverage are limited to substantive articles or reports and emphasize legislative, regulatory, and other legal aspects, as well as social, economic, and environmental impacts. *EAPA* is available from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The annual subscription price is $72.00 for domestic (North America) or $90.00 for foreign (outside North America) subscribers; a single issue is $5.00 or $6.25, respectively.

Energy Research Abstracts (ERA)
A comprehensive semimonthly abstract journal devoted to all areas of energy-related information produced by the Department of Energy, other U. S. government organizations, and foreign governments. *ERA* is available from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The annual subscription price for the 24 issues is $146.00 for domestic (North America) subscribers or $182.50 for foreign (outside North America) subscribers. A single issue is $14.00 or $17.50, respectively.

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DOE is prepared to grant exclusive or nonexclusive, revocable licenses under DOE-owned U. S. patents and patent applications; this semiannual publication provides abstracting and indexing coverage of this literature. *PAL* is available on subscription (use PB85-946800) from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161. The annual subscription price is $14.00 for domestic (North America) or $28.00 for foreign (outside North America); a single issue is $8.00 or $16.00, respectively.

Energy Meetings (EM)
A monthly listing of conferences, symposia, workshops, etc., pertaining to DOE's programmatic interests. *EM* is available on subscription (use PB85-901500) from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161. The annual subscription price is $40.00 for domestic subscribers and $80.00 for subscribers outside the North American continent; a single issue is $5.00 and $10.00, respectively.

The following monthly update journals are available to the public on subscription from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161; use the identifying order number (PB- No.) when subscribing. The annual subscription price (12 issues plus cumulative index) is $75.00 for domestic (North America) and $150.00 for foreign (outside North America) subscribers; a single issue is $7.00 and $14.00, respectively.

***Current Energy Patents (CEP)*–PB85-902800**
Devoted to international patent literature, including patent applications, on any aspect of energy production, conservation, and utilization.

***Energy and the Environment (EAE)*–PB85-914900**
Devoted to information on the impacts of energy-related activities and radioactive and nonradioactive pollutants on the environment.

***Fossil Energy Update (FEU)*–PB85-914600**
Devoted to information on the exploration, development, processing, and use of fossil fuels.

***Fusion Energy Update (CFU)*–PB85-915300**
Devoted to information on controlled thermonuclear fusion, including plasma and fuel research and power plant engineering and conceptual design studies.

***Solar Energy Update (SEU)*–PB85-914500**
Devoted to information on the utilization of solar energy, including biomass and tidal and wind power.

The following semimonthly bulletins are also available from the National Technical Information Service. The annual subscription rate for one volume (calendar) year (24 issues; no indexes) is $40.00 for domestic (North America) and $80.00 for foreign (outside North America) subscribers; use the identifying order number (PB- No.) when subscribing.

***Acid Precipitation (APC)*–PB85-901000**
Covers all aspects of acid precipitation, including effects and possible control measures.

***Buildings Energy Conservation (BEC)*–PB85-900700**
Covers worldwide information on the technology required for energy conservation in buildings of all types.

***Coal-Based Synfuels (CBS)*–PB85-901400**
Covers all aspects of conversion of coal into gaseous or liquid fuels.

***Coal Preparation and Pollution Control (CPC)*–PB85-900800**
Covers all aspects of coal preparation and cleaning and reducing pollution from its direct combustion.

***Direct Energy Conversion (DEC)*–PB85-946600**
Covers the following areas: photovoltaics, magnetohydrodynamics, electrohydrodynamics, thermoelectrics, thermionics, and fuel cells.

***Energy from Biomass (EFB)*–PB85-900600**
Covers worldwide information on all aspects of biomass production, conversion, and utilization for energy.

***Geothermal Energy Technology (GET)*–PB85-914700**
Covers information on the exploration, development, and utilization of geothermal resources.

***Heavy-Ion Reactions (HIR)*– PB85-900500**
Covers all aspects of heavy-ion (A > 4) reactions.

***Laser Research (LAR)*–PB85-901100**
Covers all aspects of laser research and development, but excludes applications.

***Nuclear Fuel Cycle (NFC)*–PB85-913400**
Covers all aspects of the nuclear fuel cycle, both front end and back end.

***Nuclear Reactor Safety (NRS)*–PB85-913500**
Covers the safety aspects of accident analysis, safety systems, radiation protection, decommissioning and dismantling, and security measures.

***Radioactive Waste Management (RWM)*–PB85-902900**
Covers the management aspects of transport and storage, waste processing, waste disposal, waste storage, radioactive effluents, and shipping containers.

***Solar Thermal Energy Technology (STT)*–PB85-901200**
Covers research in materials, concentrators/receivers, salinity gradients, etc., for development of efficient and reliable solar thermal conversion systems.

***Unconventional Petroleum (UCP)*–PB85-901300**
Covers all aspects of secondary and tertiary recovery of petroleum and of oil shales and tar sands.

INTERNATIONAL ENERGY PUBLICATIONS

The Office of Scientific and Technical Information (OSTI) cooperates in the publication of international abstract journals with the following: (1) International Atomic Energy Agency, International Nuclear Information System, Vienna, Austria, for *Atomindex;* (2) International Energy Agency, Biomass Conversion Technical Information Service, Dublin, Ireland, for *Biomass Abstracts;* and (3) International Energy Agency, IEA Coal Research, London, England, for *Coal Abstracts.* In each case, the cognizant foreign agency provides the non-U. S. information to OSTI for inclusion in the Energy Data Base; in turn, OSTI provides the U. S. information for input into the respective journal.

Atomindex
A semimonthly abstract journal providing worldwide coverage of information on nuclear science and technology. *Atomindex* is available by subscription from UNIPUB, 345 Park Avenue South, New York, NY 10010. The cost of an annual subscription, 24 semimonthly issues and semiannual and annual cumulative indexes, is $290.

Biomass Abstracts
A bimonthly abstract journal with comprehensive coverage of information in any step involved in the eventual conversion of biomass to energy. *Biomass Abstracts* is available free to Department of Energy components and contractors from OSTI. Non-DOE organizations may obtain *Biomass Abstracts* from Biomass Conversion Technical Information Service, Institute for Industrial Research and Standards, Ballymun Road, Dublin 9, Ireland, for 42 IR pounds per year. Make checks payable to the Institute.

Coal Abstracts
A monthly abstract journal providing comprehensive worldwide coverage of information in the field of coal science and technology. *Coal Abstracts* is available to Department of Energy components and contractors from OSTI. Non-DOE organizations may obtain *Coal Abstracts* from IEA Coal Research, Technical Information Service, 14-15 Lower Grosvenor Place, London SW1W 0EX, England, for 100 pounds sterling per year.

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ENERGY RESEARCH ABSTRACTS

ABOUT THE OFFICE OF SCIENTIFIC AND TECHNICAL INFORMATION

The Office of Scientific and Technical Information (OSTI) in Oak Ridge, Tennessee, has been the national center for scientific and technical information for the Department of Energy (DOE) and its predecessor agencies since 1946. In developing and managing DOE's technical information program, OSTI places under bibliographic control not only DOE-originated information but also worldwide literature on scientific and technical advances in the energy field and announces the source and availability of this information. Whereas the literature of science is emphasized, coverage is extended to DOE programmatic, socioeconomic, environmental, legislative/regulatory, energy analysis, and policy-related areas. To accomplish this mission, OSTI builds and maintains computerized energy-information data bases and disseminates this information via computerized retrieval systems and announcement publications such as abstracting journals, bibliographies, and update journals. Direct access to OSTI's most comprehensive data base, the Energy Data Base, is available to the public through commercial on-line bibliographic retrieval systems. The Energy Data Base and many of OSTI's energy-related data bases are available to DOE offices and contractors and to other government agencies via DOE/RECON, the Department's on-line information retrieval system. The Office of Scientific and Technical Information has developed and maintains systems to record and communicate energy-related research-in-progress information, to maintain a register of DOE public communications publications, to track research report deliverables from DOE contractors, and to test and make available DOE-funded computer software programs with scientific and management applications; OSTI also serves as adviser for special publication needs of the Department. To effectively manage DOE's technical information resources, OSTI's program is one of continual development and evaluation of new information products, systems, and technologies.

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ABOUT *ENERGY RESEARCH ABSTRACTS*

Energy Research Abstracts (ERA) provides abstracting and indexing coverage of all scientific and technical reports, journal articles, conference papers and proceedings, books, patents, theses, and monographs originated by the U. S. Department of Energy, its laboratories, energy centers and contractors. *ERA* also covers other energy information prepared *in report form* by federal and state government organizations, foreign governments, and domestic and foreign universities and research organizations. The user should remain aware that *ERA* coverage of non-report literature is limited to that generated by Department of Energy activity.

ERA is comprehensive in its subject scope, encompassing the DOE's research, development, demonstration, and technological programs resulting from its broad charter for energy sources, supplies, safety, environmental impacts, and regulation.

ERA is available on an exchange basis to universities, research institutions, industrial firms, and publishers of scientific information. Inquiries should be directed to the Office of Scientific and Technical Information, P. O. Box 62, Oak Ridge, TN 37831.

ERA is available to the public on a subscription basis from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The subscription rate for the 24 semimonthly issues is $146.00 for domestic subscribers and $182.50 for foreign subscribers. A single issue costs $14.00 (domestic) or $17.50 (foreign). The cumulative indexes will be available in printed form from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The GPO Stock Number is 061-000-00657-5 and the price is $83.00 for the Vol. 9 indexes. The cumulative indexes are also available in microfiche form from the National Technical Information Service, U. S. Department of Commerce, Springfield, VA 22161, and from Engineered Systems, P. O. Box 866, Oak Ridge, TN 37831.

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HOW TO USE *ENERGY RESEARCH ABSTRACTS*

ABSTRACTS IN *ENERGY RESEARCH ABSTRACTS*

The principal elements of abstract entries for a typical research and development report and a typical technical journal article are illustrated below.

Report number — Author(s) — Date of publication — Title — Corporate author — Availability

5785 **(BMI/ONWI-522)** **Thermal property and density measurements of samples taken from drilling cores from potential geologic media.** Lagedrost, J.F.; Capps, W. (Fiber Materials, Inc., Biddeford, ME (USA)). Dec. 1983. 179p. NTIS, PC A06/MF A01; 1; File Number DE84004926. GPO Dep.

Illegibility Code

Abstract

Density, steady-state conductivity, enthalpy, specific heat, heat capacity, thermal diffusivity and linear thermal expansion were measured on 59 materials from core drill samples of several geologic media, including rock salt, basalt, and other associated rocks from 7 potential sites for nuclear waste isolation. The measurements were conducted from or near to room temperature up to 500°C, or to lower temperatures if limited by specimen cracking or fracturing. Ample documentation establishes the reliability of the property measurement methods and the accuracy of the results.

Author(s) — Title — Journal citation — Date of publication

15701 **Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC).** McKenna, K.F.; Rej, D.J.; Tuszewski, M. (Los Alamos National Lab., NM (USA)). *Nuclear Fusion;* **23**: No. 10, 1319-1325 (Oct 1983).

Abstract

Zero-dimensional power balance calculations are performed for a quasi-static, purely Ohmically heated field-reversed configuration. Without compression, the constraint imposed by radial pressure balance limits the power input. Estimates of the energy loss from impurity line radiation as well as from classical and anomalous transport are given. Effects of cold puff gas injection are also investigated.

INDEXES TO *ENERGY RESEARCH ABSTRACTS*

Five indexes are provided for approaching the contents of each issue of *Energy Research Abstracts (ERA)*. Each index is preceded by an introduction that details the organization of the index and the principles by which it was compiled. The reader is referred to these introductions for information not found in the index examples that follow.

• Corporate Author Index

Technical report literature is indexed using the name of the organization or institution responsible for the issuance of the report.

5785 (BMI/ONWI-522) **Thermal property and density measurements of samples taken from drilling cores from potential geologic media.** Lagedrost, J.F.; Capps, W. **(Fiber Materials, Inc., Biddeford, ME (USA)).** Dec. 1983. 179p. NTIS File Number DE84004926. GPO Dep.

is indexed as:

Fiber Materials, Inc., Biddeford, ME (USA)

• Personal Author Index

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

Capps, W., *See* Lagedrost, J. F.
Lagedrost, J.F., Thermal property and density measurements of samples taken from drilling cores from potential geologic media, 9:5785 (R;US)
McKenna, K.F., Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC), 9:15701 (J;US)
Rej, D.J., *See* McKenna, K.F.
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• Subject Index

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles, informative phrases, or both specific to these entries are arranged alphabetically under the entries.

SALT DEPOSITS
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• Contract Number Index

DOE technical report literature is indexed using contract numbers. This index contains the contract number with corresponding abstract and report numbers.

AC06-76RL01830 **Fiber Materials, Inc., Biddeford, ME (USA)**
9:5785 BMI/ONWI-522

• Report Number Index

Technical report literature is also indexed using report numbers. This index includes information on where individual reports may be obtained. Patents and conference papers are indexed here as a matter of convenience. When a report is supplied under a File Number, that number is included in the availability statement. A file number–report number correlation is included for convenience.

BMI/ONWI-522	9:5785	NTIS, PC A09/MF A01. File Number DE84004926, Distribution Category MN-70

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CEA Centre d'Etudes de Saclay
GIF-sur Yvette Cedex, France

Fachinformationszentrum
Energie, Physik, Mathematik GmbH
Karlsruhe, Federal Republic of Germany

IEA Biomass Conversion Service
Dublin, Ireland

IEA Coal Research
Technical Information Service
London, England

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New York, NY

University of Tennessee
Graduate School of Library and Information Sciences
Knoxville, TN

Communication concerning the editorial policy and content of *Energy Research Abstracts* should be addressed to the Editor, *Energy Research Abstracts,* Office of Scientific and Technical Information, P. O. Box 62, Oak Ridge, TN 37831.

SUBJECT CONTENTS (NUMERICAL LISTING)

Six-digit subject category numbers are used in the storage, retrieval, and manipulation of bibliographic information entered into DOE's computerized bibliographic information system. The six-digit category numbers are utilized as if they were three pairs of two-digit numbers, the first two pairs being used to arrange the abstract content of *Energy Research Abstracts*. The following listing includes the totality of the 39 first-level and 293 second-level subject categories used. Because each issue of *ERA* announces only those documents becoming available during a semimonthly period, some subject categories may not be represented in every issue. The complete subject category scheme with scope definitions and limitations is available as DOE/TIC-4584-R6 from NTIS for $9.50.

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ENERGY RESEARCH ABSTRACTS

01 COAL AND COAL PRODUCTS

REFER ALSO TO CITATION(S) 29694, 31151

29613 (DOE/METC—84-23, pp 13-22) **US fossil program - an overview.** Adams, M.R. (Dept. of Energy, Washington, DC). Jun 1984. NTIS, PC A99/MF A01. File Number DE84009251. (CONF-8010382—).

From Morocco/United States oil shale colloquium; Rabat, Morocco (1 Oct 1980).

An overview of the US fossil fuel program is presented. The energy objectives for the US as well as the research and development activities necessary to meet these objectives are discussed.

29614 **(IS-EMRRI—20) [Mining and mineral-related research]. Final report, October 1, 1982-September 30, 1983.** (Iowa State Univ. of Science and Technology, Ames (USA). Iowa State Mining and Mineral Resources Research Inst.). Dec 1983. Contract W-7405-ENG-82. 80p. NTIS, PC A05/MF A01; GPO Dep. File Number DE85011355.

An industrial process was developed to recover iron ore from discarded power plant fly ash based on magnetic separation and caustic leachings. An electrowinning method was developed for copper using a fluidized bed electrochemical reactor. A method was improved to test rock strength in underground mine workings. A patentable safety device was developed to test directly shear components on the inside walls of underground mines using pulse velocity measurement of induced fractures. The thermal behavior of minerals commonly associated with US coals was studied kinetically using heating-stage microscopy. A mathematical model was formulated to monitor and predict the transport of fugitive dust from a surface mine environment.

29615 **(IS-EMRRI—21) [Mining and mineral-related research.] Final report, July 1, 1983-June 30, 1984.** (Iowa State Univ. of Science and Technology, Ames (USA). Iowa State Mining and Mineral Resources Research Inst.). Sep 1984. Contract W-7405-ENG-82. 98p. NTIS, PC A05/MF A01; GPO Dep. File Number DE85011354.

Significant research was conducted in mining and mineral related disciplines. The Institute has: continued investigating recovery of platinum group metals from spent catalysts; developed a method of rapid dissolution to analyze coal and minerals; initiated the characterization of iron sulfides and silicates in a mafic silicate melt; identified an improved refractory and its properties for coal gasifiers; identified improved mechanical properties of refractories for coal gasifiers; continued the development of a process to desulfurize gypsum in a fluidized bed reactor system in order to produce lime and sulfur dioxide for industrial use; developed a technique to utilize coal-derived fly ash in combination with mining wastes for use both in reclamation or surface-mined land and in the construction industry; continued to assess the properties of limestones for use as sorbents in fluidized bed combustion; continued development of an industrial process to recover minerals from coal-fired power plant fly ash; improved the application of a practical in-situ strength test to enhance the safety of underground mine workings; and continued research to determine the effect of nitrogen-fixing growth on restored spoil banks.

29616 **(ORNL—6162) Fossil Energy Program. Quarterly progress report for the period ending March 31, 1985.** (Oak Ridge National Lab., TN (USA)). May 1985. Contract AC05-84OR21400. 133p. NTIS, PC A07/MF A01; GPO Dep. File Number DE85013531.

This report covers progress made during the period January 1 through March 31, 1985, for research and development projects that contribute to the advancement of various fossil energy technologies. Projects on the Fossil Energy Program are supported by DOE Office of Fossil Energy, DOE Office of Basic Energy Sciences, the Electric Power Research Institute, and the Tennessee Valley Authority. The Fossil Energy Program organization chart is shown in Appendix A. Summaries and progress reports are presented for the following tasks: (1) materials research and development; (2) fossil energy environmental programs; (3) coal conversion development; (4) process analysis and development; (5) generalized equilibrium models of liquid and gaseous fuel supply; (6) fluidized bed combustion joint program; and (7) coal chemistry.

0104 Processing

REFER ALSO TO CITATION(S) 29646, 29648, 29651, 29652, 29657, 30066, 31656, 31657

29617 **(BNL—36367) Flash hydropyrolysis and methanolysis of coal with hydrogen and methane.** Steinberg, M. (Brookhaven National Lab., Upton, NY (USA)). Apr 1985. Contract AC02-76CH00016. 30p. (CONF-850512—1). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85013290.

From Beijing international symposium on hydrogen systems; Beijing, China (7 May 1985).

The process of flash pyrolysis consists of rapidly heating a carbonaceous material to elevated temperatures ($\geqq 10^{4}$°C/sec usually to temperatures above 700°C) with either a reactive or nonreactive gas, allowing reaction to take place at elevated temperature for short periods of time ($\leqq$ 10 sec) and quickly cooling ($\geqq 10^{2}$°C/sec) the reaction system to terminate the reaction. The carbonaceous material is depolymerized into short chain and smaller light molecules which can, at the elevated temperature, react with each other or react with the pyrolyzing gas, and upon fast cooling, the lighter products are stabilized preventing repolymerization and char formation. When hydrogen is used as the pyrolyzing gas, the process is referred to as flash hydropyrolysis (FHP). When methane is used, the reaction is referred to as flash methanolysis (FM). The process can also be extended to steam, which is then referred to as flash hydrolysis. 21 refs., 17 figs., 2 tabs.

29618 **(DOE/ER/10488—T1) Gasification of disordered carbons (chars). Final report.** Jenkins, R.G. (Pennsylvania State Univ., University Park (USA)). Dec 1984. Contract AC02-79ER10488. 12p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85005880.

A series of complementary, fundamental studies has been made on the topic of the carbon-oxygen reaction. An examination has been made into the quantification and activity of carbon active sites and the role they play in determining the gasification rates of a range of carbons. The carbons included a spectroscopically pure graphite, a polymer-derived isotropic char and a graphitized carbon black. Reaction kinetics of the carbon-oxygen reaction were made over a wide range of oxygen pressures 5 Pa-6.4 MPa. Temperatures were in the range of 733 K-973 K. Evidence has been found that even for high purity carbons there is a nontrivial influence of minute quantities of inorganic impurities in terms of gasification and the production of carbon dioxide. It was found that the presence of added Pt (~ 1% wt) on to a graphitized carbon black increases gasification reactivity by about 200-fold. The Pt catalyzed reaction was found to be zero order and have an activation energy of 220 kJ/mole. From mechanistic studies, it was concluded that extremely small (1-2 nm), Pt particles in contact with the carbon active sites are the dominating catalytically active particles. The dispersion of these small particles does not change appreciably with carbon burn-off.

29619 (DOE/MC/20417—1825) Novel sorbents for high temperature regenerative H_2S removal. Quarterly report No. 4, November 1984-January 1985. Flytzani-Stephanopoulos, M.; Gavalas, G.R.; Sharma, P.K. (Jet Propulsion Lab., Pasadena, CA (USA)). Mar 1985. Contract AI21-83MC20417. 30p. (JPL/D—2274). NTIS, PC A03/MF A01; GPO Dep. File Number DE85009891.

The overall objective of this program is to develop improved regenerable sorbents for the high-temperature desulfurization of coal-derived gas streams. The aim is to reduce the H_2S level, preferably in a single stage, from a few percent down to 1 ppM. The specific objectives of this project are to synthesize, characterize and test two classes of sorbents. One consists of eutectic mixtures of metal oxides (e.g., $ZnO-V_2O_5$, $CuMoO_4-MoO_3$) in the form of a melt coating the pore surface of a high surface area solid support. The second class of sorbents includes unsupported mixed oxides, in the form of solid solutions or solid compounds, e.g., Zn-Fe/sub x/-O/sub y/, Cu-Fe/sub x/-O/sub y/, prepared as highly dispersed microcrystalline solids. The principal characteristics of both classes of sorbents are rapid kinetics of absorption, high absorption capacity and good regenerability. During this reporting period, parametric studies of sulfidation/regeneration with the mixed oxide sorbents CFA (Cu-Fe-Al-O) and CM (Cu-Mo-Al-O) both prepared in porous, microcrystalline form were performed. These two types of sorbents were identified in our previous work as very efficient, high performance materials for single-stage H_2S removal at temperatures higher than 600°C. Experimental procedures and results are discussed. 15 refs., 4 figs., 4 tabs.

29620 (DOE/MC/21377—T1) ASPEN sensitivity study for the Great Plains Gasification Plant. Technical progress report, May 1-31, 1985. Cascone, R.F.; Farrell, R.J. (Scientific Design Co., Inc., New York (USA)). 13 Jun 1985. Contract AC21-84MC21377. 98p. NTIS, PC A05/MF A01; GPO Dep. File Number DE85013357.

During the period 5/1/85 through 5/31/85 work was performed on the following tasks: Task No. 1-2 Methanation Model; and Task No. 1-3 Rectisol Model. The first task in providing a rating model of the Methanation Section was to develop a reaction kinetic expression that can be used in ASPEN. It is intended to insert this expression in a separate user subroutine that will be called by the RPLUG reactor model of ASPEN. RPLUG will be used in place of RGIBBS, which is used in the present flowsheet model of the Methanation Section. Based on the recommendations contained in the final topical report for the Rectisol Plant (February 1985), work was begun on: (1) attempting to merge the simulation of the Main Sequence and the Methanol Recovery Sequence; and (2) verification of the major assumptions made in preparing these simulations by reviewing the Rectisol Plant PMX diagrams.

29621 (DOE/PC/30209—T13) Solvent tailoring in coal liquefaction based on critical properties of physical solvating agents and hydrogen donors. Progress report, August 1980-January 1981. Williams, D.C.; Guin, J.A.; Curtis, C.W. (Auburn Univ., AL (USA). Coal Conversion Lab.). 1981. Contract FG22-80PC30209. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85012855.

As an initial study of the role of solvation in liquefaction mechanisms, two basic types of solvents, aliphatics and aromatics, were examined. That is synergetic effects between these types of compounds and a hydrogen donor on coal solvation were studied. Tetralin, which is known to be an effective hydrogen donor, was used here as the hydrogen donor. The aliphatics examined were observed to have an adverse effect on conversion, which was assumed to be related to their poor solubility for the liquefaction products. The synergetic effects of several aromatics having different number of condensed rings in binary mixture with tetralin on conversion were also evaluated. Low conversions resulted when the reaction mixture contained highly volatile aromatics like benzene mixed with tetralin and a 1:1 tetralin-to-coal (T/C) ratio. These low conversions were also assumed to result because of poor solution/dispersion of liquefaction products. Highly volatile compounds like benzene exist mostly in the vapor, or fluid, phase at liquefaction temperature, and their solvation or extraction power varies with their density. Under the conditions used in this work, the density of the benzene could have been too low to allow proper extraction of products and reduce related mass transfer effects. The effect of varying the solvent-to-reactor-free volume ratio on conversion in the presence of compounds like benzene is yet to be evaluated. This is to be done in an hydrogen atmosphere as well as in an inert atmosphere. Details of the experimental methods and results are presented. 29 refs., 6 figs., 6 tabs.

29622 (DOE/PC/30236—T2) Mechanisms of fatigue in coal liquefaction environments. Progress report. Gross, T.S. (Kentucky Univ., Lexington (USA)). 1 Apr 1983. Contract FG22-80PC30236. 25p. NTIS MF A01; 2; GPO Dep. File Number DE85008527.

The second major thrust of Mr. Kanga's research was the development of an electrical resistance fatigue crack initiation gage capable of withstanding corrosion from coal liquefaction environments. His efforts were unsuccessful. First, an Al_2O_3-Al-Al_2O_3 sandwich type gage with the Al layer as the conducting path was investigated. Second, a commercial corrosion resistant coating, Aremco 567, was evaluated. We will attempt to construct a crack initiation gage. The most promising approach would be to directly sputter Al_2O_3 on to the metal substrate. The objective of the present investigation is to carry out low-cycle fatigue experiments on 316 stainless steel under simulated liquefaction environments and to evaluate the effects of such environments on the modes and mechanisms of fatigue failure. The activities during this report period concentrated on: (1) further studies on the effects of environment on fatigue crack initiation and propagation in 316 stainless steel subjected to rotating bending fatigue at room temperature; and (2) development of a suitable technique for the measurement of fatigue crack growth during axial loading in simulated coal liquefaction environments. The progress since our last report consists mainly of the preparation, submittance and examination of the Master's thesis of Mr. Percy Kanga, the student employed by this contract. His research effort had two thrusts, the first of which was to investigate the room temperature crack initiation behavior of 2-1/4 Cr-1 Mo pressure vessel steel and 316L stainless steel. The criteria chosen to evaluate crack initiation was to measure the number of cycles to produce a 0.100" crack at a sharp notch. The results of the measurement of the two steels show that the two steels have very close to the same crack initiation resistance. The threshold for crack initiation is the same for both metals.

29623 (DOE/PC/40009—T8) Advanced coal liquefaction catalyst development. Quarterly progress report No. 9, October 1-December 31, 1983. Mahoney, J.A.; Schwartz, M.M.; Wittrig, T.S. (Amoco Research Center, Naperville, IL (USA)). Sep 1984. Contract AC22-81PC40009. 38p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85012307.

The objective of this program is to identify advanced coal liquefaction catalyst and operating conditions for use in optimized, two-stage direct coal liquefaction process applications and to experimentally test catalysts in a two-stage reaction system for supporting the improvement of this process. A development plan consisting of eight project tasks has been formulated and is summarized as follows: Task 1 - project work plan; Task 2 - literature survey; Task 3 - feed materials specification; Task 4 - continuous aging unit modification; Task 5 - thermal reaction process variable study; Task 6 - two-stage optimization; Task 7 - project coodination; and Task 8 - ebullated bed testing. This report summarizes progress in tasks 5 and 6 during the last quarter. Some of the conclusions are as follows: (1) Two-stage liquefaction of Illinois No. 6 coal with a high-severity first stage dissolver and low space velocity hydrotreater offers substantial advantages over one-stage liquefaction on Amoco's continuous coal liquefaction pilot plant. Improvements are observed for solubility conversions, resid conversion and heteroatom removal. (2) The performance of the unit in high-severity first stage configuration does not degrade over the seven day period of the experiment. This indicates that the catalyst is not deactivating over that period. (3) Operation of the dissolver at low severity produces results that are not significantly better (and in some cases, worse) than one-stage processing. (4) Preliminary data indicate that two-stage liquefaction of Wyodak coal also will be advantageous compared to one-stage processing. 2 refs., 13 figs.

29624 (DOE/PC/40091—T15) Development of significantly improved catalysts for coal liquefaction and upgrading of coal extracts. Final report, September 28, 1981-February 28, 1985. Sinha, V.T.; Kutzenco, P.D.; Preston, W.J.; Ungar, J.K.; Brinen, J.S.; Muchnick, T.L.; Hyman, D. (American Cyanamid Co., Stamford, CT. Chemical Research Div.). 1985. Contract AC22-81PC40091. 453p. NTIS, PC A20/MF A01; 1; GPO Dep. File Number DE85013583.

New beaded catalysts for direct liquefaction of coal and for upgrading of coal-derived resids were studied during the period of September 1981 through February 1985. Catalysts prepared on rehydratable alumina supports were screened for initial activity in a batch autoclave test. Samples with unimodal and bimodal pore size distributions were included. They contained various levels of MoO_3 and promoters such as NiO and CoO. Leads from initial activity tests were pursued in catalyst aging runs in a continuous flow unit. Aging trials were carried out with Illinois No. 6 coal, Wyodak coal, and Wilsonville thermal deashed resid as feeds. Different catalysts with improved activity vis-a-vis baselines were identified for each of the feeds. Results strongly indicate that optimization of catalyst performance is feed dependent. The cold-flow ebullation characteristics of bead catalysts were also studied. Sizes and size ranges equivalent in behavior to 1/16 inch and 1/32 inch extrudates, used in ebullated bed reactors, were determined. Two empirical models correlating three-phase fluidized bed expansion with operating variables were developed. Additionally, techniques to study organic and inorganic constituents of catalyst surfaces were explored. These included ESCA, electron microprobe, and Auger spectroscopy. 44 refs., 16 figs., 26 tabs.

29625 (DOE/PC/40778—T4) Optimization of various coal conversion systems. Final report. Whiting, W.B.; Hano, T.; Pattipati, R.R.; Tong, T.M. (West Virginia Univ., Morgantown (USA). Dept. of Chemical Engineering). 1984. Contract FG22-81PC40778. 122p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE85012500.

Computer simulations of two coal-liquefaction processes are presented. For the SCR-II preheater/transfer-line/reactor system, a finite-difference dynamic simulation was developed and found to give qualitative agreement with pilot-plant startup data. A sensitivity analysis on physicochemical and model parameters with this dynamic simulator indicates areas in which future work will be most profitable. A steady-state simulation for the H-coal process flowsheet shows good agreement with pilot-plant data when some model parameters are adjusted to these data. All computer programs are in ANSI FORTRAN (1966) and are included in this report. Two general kinetic models (a 6-path and a 9-path model) for coal liquefaction have been developed. Rate constants (including temperature dependence and catalytic effects) for both of these models have been determined for the available kinetic data. 15 refs., 10 figs., 2 tabs.

29626 (DOE/PC/40786—6) Heterogeneous kinetics of coal gasification. Quarterly technical progress report, 1 October 1982-31 December 1982. Calo, J.M.; Ellison, S.E. (Brown Univ., Providence, RI (USA). Div. of Engineering). Jan 1983. Contract FG22-81PC40786. 32p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85013001.

In the current quarterly technical progress report we present accomplishments and results in four areas: (1) progress made on the automated data acquisition system; (2) transient CO_2 gasification data obtained for Darco lignite char (PSOC No. 623) [These data represent the first obtained with the automated mass programming and data acquisition system developed for this project. From this data it is concluded that the apparent decrease in the "effective" active site concentration with increasing temperature, observed in our previous data, appears to be largely irreversible.]; (3) the final version of the transient steam addition to be used for steam gasification studies; and (4) consideration of the possibility of multiple steady-states for steam gasification in a well-mixed reaction system. From this analysis it is concluded that the occurrence of this phenomenon for this system is unlikely. 3 refs., 16 figs., 1 tab.

29627 (DOE/PC/40786—7) Heterogeneous kinetics of coal gasification. Quarterly technical progress report, 1 January 1983-31 March 1983. Ellison, S.E.; Calo, J.M. (Brown Univ., Providence, RI (USA). Div. of Engineering). Jan 1983. Contract FG22-81PC40786. 87p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85013000.

The current quarterly technical progress report focuses on the results of a study conducted on multiparameter estimation schemes for determining the parameters in the various char gasification kinetic models that are applied to the transient kinetic data. The work reported herein is primarily that of Mr. S.E. Ellison, and has also been submitted as his Sc.B. thesis at Brown University. 26 refs., 6 figs., 2 tabs.

29628 (DOE/PC/40792—T7) Studies of initial reaction steps in the gasification of coal and selected model compounds. Final technical report, September 1981-August 1983. Chu, C.J.; Fredin, L.; Badachhape, R.B.; Hauge, R.H.; Margrave, J.L. (Rice Univ., Houston, TX (USA). Dept. of Chemistry). 1983. Contract FG22-81PC40792. 97p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85013003.

The objective of this work is to study the chemistry and reaction mechanism of species resulting from the pyrolysis of coal particles. Emphasis is placed on clarifying and understanding coal chemistry during the early initial steps of coal gasification where highly reactive gas phase intermediate species can be observed by rapidly bringing the coal to reaction temperature. The experiments are designed such that reactive gas phase intermediates can leave the reaction zone without wall collisions and be trapped with an inert gas on a cold (12°K) matrix surface. Identification and characterization of these gaseous species and possibly free radicals are performed in a newly designed matrix isolation system coupled to a high resolution Fourier Transform I.R. Variables such as temperature, coal particle size, heating technique, tar formation, and addition of isotopically enriched reactant species were studied. Structural data of coal from fluorocoal and polycyclic aromatic model compounds were also pursued. 23 refs., 48 figs.

29629 (DOE/PC/50033—T3) Syn-fuel reciprocating charge pump improvement program. Quarterly report, July 1-September 30, 1984. (Ingersoll-Rand Research, Inc., Princeton, NJ (USA)). 1984. Contract AC22-82PC50033. 8p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85013013.

The main effort during the third quarter of 1984 has been to debug the 3V3 pump slurry valves. The valves become stuck as sand packs around them. The valves have been modified and are being reinstalled for testing. The operating procedures for both the test loop and the reciprocating test pump have been finalized. 1 fig.

29630 (DOE/PC/50033—T4) Syn-fuel reciprocating charge pump improvement program. Quarterly report, October 1-December 31, 1984. (Ingersoll-Rand Research, Inc., Princeton, NJ (USA)). 1984. Contract AC22-82PC50033. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85013014.

Two significant accomplishments were achieved in the fourth quarter of 1984. The 3V3 slurry pump valves were successfully modified and now operate correctly. The 200 h accelerated sand-water test of the pump and seals was started and completed. The conventional plunger/packing failed twice during this test while under the same conditions the floating piston seals maintained a positive seal between the slurry and buffer liquids. 6 figs.

29631 (DOE/PC/50053—T5) Feasibility analysis for data base design. (Orkand Corp., Silver Spring, MD (USA)). 31 Jan 1983. Contract AC22-82PC50053. 50p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85004239.

This report summarizes the results of a study conducted for the Department of Energy's Pittsburgh Energy Technology Center (PETC) on the design of a coal liquefaction technology data base (LTDB). The data base was designed to collect and store data generated from the four major government-sponsored coal liquefaction projects, Solvent Refined Coal-I, Solvent Refined Coal-II, H-Coal and EDS. The specific objectives of The Orkand Corporation study were to: review current PETC data collection and processing procedures; assess user data requirements; examine other synthetic fuels data management systems; evalute PETC data dissemination options; and recommend system enhancements. The PETC system has collected and indexed over 10,000 coal liquefaction documents, including technical reports, computer printouts, operational runs, blueprints, engineering drawings, repair records, etc. These materials span a variety of subject categories, including engineering, economic, environmental and management data. At present, PETC has collected over 95 percent of the available nonproprietary data on SRC-II; H-Coal and EDS data collection efforts are expected to be completed by the fall of 1983, with negotiations for the transfer of SRC-I data currently ongoing. PETC uses a five-stage cycle for processing information. This involves: (1) indexing all materials; (2) checking for non-useful data; (3) reviewing documents for completeness; (4) abstracting high quality high/high utility data; and (5) conducting data analysis.

29632 **(DOE/PC/50798—T5) Catalyzed gasification of coal: isotope and XPS studies. Reporting period: February 16, 1985-May 15, 1985.** Falconer, J.L. (Colorado Univ., Boulder (USA)). 16 May 1985. Contract FG22-82PC50798. 4p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85011914.

This research aims to elucidate the reaction mechanism for the catalytic gasification of coal by metal carbonates, by identifying the reaction pathways and the active form of the catalyst. The insight into the mechanism will help in improving process kinetics of coal gasification. Alkali carbonates and alkaline earth carbonates are being used to catalyze the carbon dioxide-carbon gasification reaction. Temperature-programmed reaction, isotopic labeling of the carbon and oxygen atoms in the carbonate, and mass spectrometric detection of labeled products are used to identify reaction pathways. X-ray photoelectron spectroscopy (XPS) analysis of carbon-carbonate mixtures is used, at reaction conditions, to determine the chemical state of the carbonate.

29633 **(DOE/PC/50798—T6) Catalyzed gasification of coal: isotope and XPS studies. Reporting period: November 15, 1982-February 14, 1983.** Falconer, J.L. (Colorado Univ., Boulder (USA)). 15 Feb 1983. Contract FG22-82PC50798. 8p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85012844.

This research aims to elucidate the reaction mechanism for the catalytic gasification of coal by metal carbonates, by identifying the reaction pathways and the active form of the catalyst. The insight into the mechanism will help in improving process kinetics of coal gasification. Alkali carbonates and alkaline earth carbonates are being used to catalyze the carbon dioxide-carbon gasification reaction. Temperature-programmed reaction, isotopic labeling of the carbon and oxygen atoms in the carbonate, and mass spectrometric detection of labeled products are used to identify reaction pathways. X-ray photoelectron spectroscopy (XPS) analysis of carbon-carbonate mixtures is used, at reaction conditions, to determine the chemical state of the carbonate. 2 figs.

29634 **(DOE/PC/50799—T7) Enhanced coal liquefaction by hydropyrolysis in supercritical fluids. Quarterly report, October-December 1984.** Paulaitis, M.E.; Klein, M.T.; Stiles, A.B. (Delaware Univ., Newark (USA). Dept. of Chemical Engineering). 1984. Contract FG22-82PC50799. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85010075.

This research program involves a fundamental investigation of a novel coal liquefaction process that combines pyrolysis, supercritical-fluid solvent extraction, and in situ hydrogen generation through catalytic dissociation of methanol. The experimental work consists of determining: (1) coal pyrolysis reaction pathways, kinetics and mechanisms, and the identity and structure of reaction intermediates, (2) solubilities of coal-derived species in supercritical water, methanol, and water + methanol mixtures, and (3) reaction pathways involved in the generation of hydrogen by catalytic dissociation of methanol to carbon monoxide and hydrogen, and through the shift of carbon monoxide. Both model coal compounds and actual coals are to be studied. 2 refs., 6 figs.

29635 **(DOE/PC/60039—5) Phase behavior of coal fluids: data for correlation development. Reporting period: November 1, 1984-April 30, 1985.** Robinson, R.L. Jr.; Anderson, McRay; Barrick, M.; Bufkin, B. (Oklahoma State Univ., Stillwater (USA). School of Chemical Engineering). 1985. Contract FG22-83PC60039. 20p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85012001.

The overall objective is to develop accurate predictive methods for representation of vapor-liquid equilibria in systems encountered in coal-conversion processes. The objectives of the present project include: (1) measurements of binary vapor-liquid phase behavior data for selected solute gases (e.g., H_2, CO, CO_2, NH_3, H_2S) in a series of heavy, primarily aromatic, solvents (e.g., benzene, naphthalene, phenanthrene) to permit evaluation of interaction parameters in models for phase behavior. Both solubilities of the gases in the liquid phase and of the heavy solvents in the gas phase will be determined; (2) measurements on ternary systems in which high-melting-point solvents (e.g., pyrene, chrysene, triphenylene) are dissolved in more volatile aromatics to provide mixed solvents; this will facilitate measurements at lower temperatures than would be possible in the pure high-melting-point aromatic solvents, which would be solid at operating conditions; (3) evaluation of existing equations-of-state and other models for representation of phase behavior in systems of the type studied experimentally; development of new correlation frameworks as needed; and (4) generalization of the interaction parameters for the solutes studied to a wide spectrum of heavy solvents; presentation of final results in formats useful in the design/optimization of coal liquefaction processes. During the present report period, our recent data on CO_2 solubilities in naphthenic and aromatic solvents have been analyzed. In addition, a correlation for phase behavior in CO_2 + heavy n-paraffins has been developed and presented at the Houston AIChE meeting. New experimental data have been obtained for CO_2 + n-dodecane at 323.2, 344.3 and 373.2°K and for ethane + trans-Decalin at 323.2 and 373.2°K. 11 refs., 10 figs., 3 tabs.

29636 **(DOE/PC/60813—7) Hydrotreatment catalyst activity enhancement. Quarterly report No. 7, February 1, 1985-April 30, 1985.** Seapan, M.; Crynes, B.L. (Oklahoma State Univ., Stillwater (USA). School of Chemical Engineering). 28 May 1985. Contract FG22-83PC60813. 24p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85012302.

The catalyst samples from Tetralin hydrogenation experiments were analyzed. The coking results were statistically inconclusive. Titanium profiles in catalyst pellets showed two maxima, one near the edge and the other at the center of the pellet, indicating that two different precursors were responsible for titanium deposition. The feasibility of ESR spectroscopy to study the role of titanocene dichloride in the free radical mechanisms is being investigated. 4 refs., 13 figs., 6 tabs.

29637 **(DOE/PC/70786—T2) Transition metal catalysis of hydrogen shuttling in coal liquefaction. Quarterly technical progress report, December 1, 1984-February 28, 1985.** Eisch, J.J. (State Univ. of New York, Binghamton (USA). Dept. of Chemistry). 30 Apr 1985. Contract FG22-84PC70786. 4p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85011491.

The ultimate objective of this research is to uncover new catalytic processes for the liquefaction of coal and for upgrading coal-derived fuels by removing undesirable organosulfur, organonitrogen, and organooxygen constituents. Basic to both the liquefaction of coal and the purification of coal liquids is the transfer of hydrogen from sources such as dihydrogen, metal hydrides or partially reduced aromatic hydrocarbons, to the extensive aromatic rings in coal itself or to aromatic sulfides, amines, and ethers. Accordingly, this study is exploring how such crucial hydrogen-transfer processes might be catalyzed by soluble, low-valent transition metal complexes under moderate conditions of temperature and pressure. By learning the mechanism whereby H_2, metal hydrides or partially hydrogenated aromatics can transfer hydrogen to model aromatic compounds, under homogeneous transition-metal catalysis, we hope to identify new methods for producing superior fuels from coal. During the second quarter the following aspects were pursued: (1) the appointment of the postdoctoral research associate has been made; (2) the choice and purchase of a high-performance liquid chromatograph (Perkin-Elmer) have been completed; (3) the final data for our manuscript on the desulfurizing action of the bis(1,5-cyclooctadiene)nickel-$LiAlH_4$ combination have been collected; (4) experiments have begun on the nickel-catalyzed hydrogen shuttling reactions of dihydroaromatics, such as 1,4-cyclohexadiene; and (5) surveying the cleavage of carbon-element bonds by the combination of $LiAlH_4$ with 2,2′-bipyridyl(1,5-cyclooctadiene)nickel continues.

29638 (DOE/PC/70811—2) **Improved coal conversion in CO/water systems. Quarterly report No. 2, December 4, 1984-March 3, 1985.** Ross, D.S.; Hum, G.; Miin, T.C. (SRI International, Menlo Park, CA (USA)). Apr 1985. Contract FG22-84PC70811. 11p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85013247.

This research program is a study of conversion mechanisms in CO/H_2O systems. We have previously reported the conversion of an Illinois No. 6 coal to toluene-soluble (TS) product at 400°C for 20 minutes. The conversion was found to follow the water-gas-shift reaction (WGSR), $CO + H_2 \rightarrow CO_2 + H_2$. More specifically, the levels of conversion correlated with the degree of CO disappearance. The extent of CO being converted in the WGSR is controlled by the amount of KOH present. Ultimately, the level of conversion was controlled by varying the initial pH of the H_2O solution. The intermediate is believed to be formate, formed by the reaction of CO and KOH. Ross has postulated the mechanism of coal conversion in CO/H_2O systems in a recent review on aqueous conversion. It is suggested that the thermolysis of weak bibenzyl type bonds in coal conversion is not a significant process, but rather that reactions involving phenolic constituents in the coal are more important. We have synthesized a model polymer, polynaphthoquinone (PNQ), and have reduced it to its polyphenolic structure for studying the importance of phenolic functions and its correlation to coal conversion. The research is being performed in two tasks. In the first, we are investigating formate-promoted conversions of Illinois No. 6 coal. In the second, the reactions of the model polymer PNQ are being studied in the CO/H_2O system. Our objectives are to improve conversion effectiveness with formate and to determine the correlation of phenolic functions present in coal structures with conversion. This quarter, we have focused on the synthesis and reduction of PNQ. We are at present designing an appropriate microreactor system for the formate study. 7 refs., 1 fig., 1 tab.

29639 (DOE/PETC/TR—85/8) **Thermal component of residuum conversion in two-stage coal liquefaction.** Stiegel, G.J.; Lett, R.G.; Cillo, D.L.; Mima, J.A.; Tischer, R.E.; Narain, N.K. (USDOE Pittsburgh Energy Technology Center, PA). Jun 1985. 56p. NTIS, PC A04/MF A01; GPO Dep. File Number DE85013005.

An experimental investigation was conducted to ascertain the contribution of thermal reactions to the conversion of residuum in the hydroprocessing reactor of two-stage liquefaction processes. Feedstocks prepared from residuum produced at the Wilsonville Advanced Coal Liquefaction Test Facility (ACLTF) and solvents produced by the catalytic hydrotreatment of solvent obtained from the Wilsonville ACLTF were reacted in the absence of a catalyst at temperatures ranging from 720°F to 850°F. Detailed characterization of the composite feedstock and product samples as well as of three fractions of each obtained by vacuum distillation was performed to ascertain the extent of residuum conversion, heteroatom removal, and hydrogen rearrangement. The results showed that hydrogenation of the solvent portion of the hydrotreater feedstock neither enhances residuum conversion nor results in the transfer of hydrogen to the residuum. Higher reaction temperatures enhanced the removal of sulfur but had little effect on other reactions. The results suggest that the conversion of residuum in the hydroprocessing reactor of two-stage liquefaction processes must occur catalytically rather than thermally. 10 refs., 1 fig., 30 tabs.

29640 (EPRI-AP—4026) **Fate of basic nitrogen solvents in coal liquefaction. Final report.** Taylor, L.T. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA). Dept. of Chemistry). May 1985. 119p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920655.

Certain model nitrogenous donor solvents have been demonstrated to enhance the liquefaction of coals. Unfortunately the yield of distillate product has been disappointingly low and the extent of solvent loss due to degradation and incorporation into coal structures has been relatively high. The overall effectiveness of various carefully chosen model, nitrogen-containing process solvents (1,2,3,4-tetrahydroquinoline, 1-methyl-2,3,4-tetrahydroquinoline, cyclohexenopyridine, 1,2,3,4-tetrahydroisoquinoline, etc.) for the conversion of a western coal to distillate products has been established. For each liquefaction run a nitrogen balance between gas make, light ends, distillables and residuum was obtained. To further delineate and quantify the coal-solvent interaction, nitrogen and mass balance data have been obtained on the products produced from a liquefaction run performed by Kerr McGee. In both series of experiments adduction of process solvent to non-distillate and high boiling distillate materials is significant. Though some breakdown of process solvent was found, its contribution to the loss of the dynamic nitrogen component is minimal in comparison to the problem of adduction to residuum. By application of a number of analytical techniques such as Fourier transform infrared spectrometry, field ionization mass spectrostrometry, gas chromatography and high performance liquid chromatography, the chemical fate of several solvents during liquefaction is described. 17 refs., 47 figs., 13 tabs.

29641 (EPRI-AP—4030) **Integrated two-stage coal liquefaction steady-state performance. The Advanced Coal Liquefaction R and D Facility, Wilsonville, Alabama. Final report.** (Catalytic, Inc., Wilsonville, AL (USA)). May 1985. Contract AC22-82PC50041. 151p. NTIS, PC A08/MF A01; 1 - Research Reports Center, Box 50490, Palo Alto, CA 94303; GPO Dep. File Number DE85012872.

This report presents the operating results for Run 245 at the Advanced Coal Liquefaction R and D Facility in Wilsonville, Alabama. This run was made in an "all-distillate" Integrated Two-Stage Liquefaction (ITSL) mode using Illinois 6 coal from the Burning Star mine. The primary run objective was to obtain steady-state ITSL performance by replacing spent HTR reactor catalyst with fresh, sulfided catalyst. Secondary objectives were to maintain an "all-distillate" (minimum resid production) product slate and to demonstrate the effects of catalyst addition on the net gas production and hydrogen consumption. Run 245 began on 7 November, 1983, and continued through 12 February, 1984. During this period, 179.0 tons of coal was fed in 2045 hours of operation. Eight special product workup material balances were defined, and the results are presented herein. 6 refs., 32 figs., 20 tabs.

29642 (STEV-BF—83-15) **Gasification of biomass and peat. Progress report for the period 810701-830630.** Sjoestroem, K. (Statens Energiverk, Stockholm (Sweden)). 1983. 196p. (In Swedish). (KTR—83-22). NTIS (US Sales Only), PC A09/MF A01. File Number DE85750840.

The two-year period 6 of the gasification project has been completed according to the plans. The experimental studies have been carried out in the pressurized fluid bed (LDU) and under atmospheric pressure in the flash pyrolysis unit and in the long-term test unit (LRU). The following points have been studied in the LDU: Non-catalytical pressurized conversion of tar and methane at high temperatures. Catalytical pressurized conversion of tar and methane. Pressurized conversion of tar over dolomite. Different principles for continuous feeding of biomass into the fluidized bed. The following points have been studied in the LRU: Same studies as the three first points in the LDU but at atmospheric pressure and extended intervals for the remaining parameters. Sulphur poisoning and carbon formation studies have been initiated. Results: The conversion of the tar and the carbon black are almost complete over dolomite and Ni-catlysts. The Ni-catalysts are highly active for methane conversion. The methane conversion is very little effected by the total pressure. A theoretical model work for scale up has been initiated. Four models simulating different phenomena at the gasification have been created.

29643 (STEV-TORV—83-10) **Development of a pulverized fuel from specially treated peat.** Kinnerberg, H. (Statens Energiverk, Stockholm (Sweden)). Oct 1983. 18p. (In Swedish). NTIS (US Sales Only), PC A02/MF A01. File Number DE85750848.

The prepared, pulverized peat powder fuel appears to be a non-dusty, easy to handle and storable fuel. The agglomerating agent causes, however, an increased internal friction and increased particle bondings, which may complicate feeding, conveying, discharge and other handling operations. Those complications are possible to solve with established technology. The prepared pulverized peat powder fuel is non-explosible and causes no dust-explosion hazards. The prepared pulverized peat powder had very good combustion properties compared to other pulverized fuel. It is ignitible in the combustion chammber and is rapidly combusted. Thus the basic idea of preparing pulverized peat powder with an agglomerating agent has been verified.

29644 **Gasification kinetics and surface areas of catalyzed carbonaceous chars.** Kosky, P.G.; Lamby, E.J.; McKee, D.W.; Spiro, C.L. (General Electric R & D Center, Schenectady, NY). pp 180-181 of 16th Biennial Conference on Carbon. University Park, PA; American Carbon Society (1983). (CONF-830711—).

From 16. American Carbon Society biennial conference; La Jolla, CA, USA (17 Jul 1983).

This paper examines the effect of alkali catalysts in raising the reactivity of coal chars. Mixtures of finely ground coals of various ranks and catalysts were pyrolyzed for 2 hr. in N_2 at 700°C. Aliquots of the chars were ground and the gasification rates in CO_2 and $H_2O(g)$ were measured in a thermogravimetric balance. BET-surface areas of the chars were measured using CO_2 and N_2. The results indicate that reactivity increases with catalyst concentration but there is a decrease in both the N_2 and CO_2 areas. It is determined that the effect of alkali catalysts in raising the reactivity of coal chars is not due to a massive increase in the internal surface area of the chars as a result of the catalyst salts.

0105 By-products

29645 (CERI-CRR—84-1) **The costs of transportation fuel from methanol versus oil sands.** Summer, B.D.; Gibson, T.; Slagorsky, Z.C. (Canadian Energy Research Institute, Calgary, Alberta). Dec 1984. 121p. Canadian Energy Research Institute, Calgary, Alberta.

The report examines the relative economic attractiveness of two alternative ways of supplying fuel in Canada in place of imported or conventional crude oil. The two options are: to build and operate a series of medium-size methanol plants using domestic natural gas as a feedstock and to blend the methanol with gasoline; or to build and operate a synthetic oil sands plant similar to the existing Syncrude Canada Ltd. plant, to refine the output into motor gasoline and deliver it to the same set of blending locations as in the first option.

29646 (DOE/MC/21382—1865) **Assessment of blast furnace retrofit for the co-manufacture of steel, electricity, and synfuels. Final report.** (Mueller Associates, Inc., Baltimore, MD (USA)). May 1985. Contract AC21-84MC21382. 96p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85011949.

The objective of this study was to assess a potentially high payoff concept through preliminary engineering. Two retrofit approaches were evaluated in the study: minimal retrofit and synfuels retrofit. The minimal retrofit approach consists of operating a blast furnace with a minimum amount of changes to its operating conditions. The blast furnace combustion temperatures and amount of gas produced are maintained at substantially similar levels to normal blast furnace operation for pig iron production. In the synfuels retrofit approach, the minimum retrofit case was upgraded to an oxygen-blown, medium-Btu gasifier suitable for the production of synthesis gas. This gas can then be converted to electricity, substitute natural gas, or methanol. This concept, which was based on converting a blast furnace to a British Gas/Lurgi slagging gasifier, appears to be technically feasible. While some engineering problems were identified, they do not appear to be insurmountable. The synfuels retrofit facility, designed to produce electricity, methanol, or substitute natural gas from coal, shows a capital investment of $1.726 billion or $62.8 per trillion Btu. When compared to a grass roots facility producing the same product slate ($70.3 per trillion Btu), the retrofit represents a savings or cost avoidance of only 10% over a new facility. It can be concluded that the economics of coal gasification, in general, are currently not favorable due to the relatively low cost and apparent availability of oil and natural gas. Even site favorable situations, such as integration with steel mill operations, do not seem to be sufficient to make blast furnace retrofits economically attractive at this time. 26 refs., 15 figs., 13 tabs.

29647 (DOE/R8/05032—T1) **Production of mineral wool from lignite coal slag.** Manz, O.E.; Eaton, L.C. (Mercer County Energy Development Board, Hazen, ND (USA)). 1 Mar 1983. Contract FG48-81R805032. 14p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85013335.

This is a report of research conducted at the University of North Dakota concerning the utilization of the "molten state" condition of lignite coal slag for the fabrication of a mineral wool insulant. The research was funded by the Mercer County Energy Development Board with monies allocated from the Department of Energy. The objective of the research was to investigate, on a preliminary basis, some critical criteria such as the chemical nature of the raw material, the ability of the slag to be fiberized, as well as the possibilities that such a insulant could indeed have a market in the immediate area. In essence it was felt that a mineral wool product could be produced at coal fired power plants which burn lignite at a minimal cost. The major cost saving would come from the fact that the raw material that would be used would not have to have a great deal of energy added at the expense of the consumer.

0106 Properties

REFER ALSO TO CITATION(S) 29713, 29715, 29790, 29791, 31669

29648 (DOE/ET/13381—T3) **Aliphatic components of coal. Final report, September 1, 1978-August 31, 1980.** Deno, N.C. (Pennsylvania State Univ., University Park (USA)). Sep 1980. Contract AC22-78ET13381. 69p. (FE—3159-1-80). NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85002197.

The principal objective of the contract was to determine the chemical structures of the aliphatic components of coals, coal macerals, and coal-derived materials. The initial concept was to develop PTFA (H_2O_2-CH_3COOH-H_2SO_4) oxidative degradations. This was done and in addition a new procedure for oxidative degradation with HNO_3 was developed. The two methods compliment each other and taken together, they allow much to be learned about the aliphatic components of coal structure. This report contains the following four appendices: (1) linear alkane chains in coals; (2) low temperature chemical fragmentation of coals; (3) chemical changes in coal liquefaction; and (4) survey of the chemical structures of twenty-seven coals as determined by oxidative degradation. All four of these papers have been processed for inclusion in the Energy Data Base.

29649 (DOE/ET/13381—T3, pp 11, App. A) **Linear alkane chains in coals.** Deno, N.C.; Curry, K.W.; Jones, A.D.; Keegan, K.R.; Rakitsky, W.G.; Richter, C.A.; Minard, R.D. Sep 1980. NTIS, PC A04/MR A01. File Number DE85002197.

In Aliphatic components of coal. Final report, September 1, 1978-August 31, 1980.

When coals are oxidized with 40% aqueous nitric acid at 60°, the products include a homologous series of linear aliphatic diacids starting with the four carbon succinic acid. These are stable under the conditions of oxidation so that their amounts and lengths measure the amounts and lengths of the saturated components of linear aliphatic chains in the coals. In one coal (PSOC-155) they account for 38% of the carbon and members of the series up to C_{28} were detected. Evidence is presented indicating that these chains are integral parts of the coal structure and not interspersed contaminants. 26 refs., 3 tabs.

29650 (DOE/ET/13381—T3, pp 13, App. B) **Low temperature chemical fragmentation of coal.** Deno, N.C.; Curry, K.; Jones, A.D.; Minard, R.; Potter, T.; Rakitsky, W.; Wagner, K.; Yevak, R.J. Sep 1980. NTIS, PC A04/MR A01. File Number DE85002197.

In Aliphatic components of coal. Final report, September 1, 1978-August 31, 1980.

Trifluoroperoxyacetic acid chemically fragments coals at 25 to 80°. The reagent is so selective for oxidizing aromatic rings and is so inert towards benzylic hydrogen that isopropylbenzene, tetralin, indan, and dihydrophenanthrene have their benzene ring(s) totally destroyed without any evidence of oxidation at the benzylic hydrogen. The fragments contain more and different structural information relative to conventional oxidations with Mn (7+), Cr (6+), HNO_3, and O_2. These latter selectively oxidize benzylic hydrogen. Products from 27 selected coals show that 9,10-dihydroanthracene and 9,10-dihydrophenanthrene units are prominent features in most bituminous coals in accord with Given's structure of coal. Their frequency accounts for the fact that no continuous fused ring structure or graphite structure exists. The only simple alkyl substituent is methyl. Liquefaction (solvent refining) sharply increases the amount of arylmethyl and aromatic structure and causes the apearance of unsubstituted phenyl groups. Nitric acid degradations have been reinvestigated and are developed into a premier method for analyzing the amounts and lengths of linear alkane chains in coals. Generally, the amounts of such chains represent 0 to 2% of the carbon in coal, but in one Utah coal they account for about 42% of the carbons. 12 refs., 6 tabs.

29651 (DOE/ET/13381—T3, pp 11, App. C) **Chemical changes in coal liquefaction.** Deno, N.C.; Curry, K.W.; Cwynar, J.E.; Jones, A.D.; Minard, R.D.; Potter, T.; Rakitsky, W.G.; Wagner, K. Sep 1980. NTIS, PC A04/MR A01. File Number DE85002197.

In Aliphatic components of coal. Final report, September 1, 1978-August 31, 1980.

Mobil Research and Development Corp. supplied five coals and their soluble and insoluble fractions after 3 minutes solvent refining and their soluble fraction after 90 minutes solvent refining. All samples were oxidatively degraded with CF_3CO_3H-H_2SO_4. The major effects of solvent refining on molecular structure were the large increases in arylmethyl, arylphenyl, and total aromatic material. Liquefaction (solvent refining) of coal involves thermolysis of benzyl-oxygen and/or benzyl-benzyl bonds as the first step in the depolymerization. This view derives from NMR studies, studies with model compounds, and oxidative degradations with $Na_2Cr_2O_7$ and $CF_3CO_3H_2$. The oxidative degradations with CF_3CO_3H are now extended to five new coals. Products have been determined from the original coal, the soluble and insoluble fraction after 3 minutes, and the soluble fraction after 90 minutes. The data are summarized in Tables 1 and 2. The best method for determining the amount of arylmethyl groups in coals is from the yield of acetic acid formed in oxidative degradation with CF_3CO_3H-H_2SO_4. The data from this method are shown in Table 1, and results are discussed. 7 refs., 4 tabs.

29652 (DOE/ET/13381—T3, pp 29, App. D) **Survey of the chemical structures of twenty-seven coals as determined by oxidative degradation.** Deno, N.C.; Cannon, C.; Curry, K.W.; Cwynar, J.E.; Jones, A.D.; Minard, R.D.; Potter, T.; Rakitsky, W.G.; Wagner, K.; Yevak, R.J. Sep 1980. NTIS, PC A04/MR A01. File Number DE85002197.

In Aliphatic components of coal. Final report, September 1, 1978-August 31, 1980.

Oxidative degradation using CF_3COOH-H_2O_2-H_2SO_4 has been applied to 27 coal samples. For 24 of the 27 samples, there are common major products and similarities in the categories of products. Two samples gave entirely different products, and a third sample had an intermediate nature. The results are interpreted as supporting aromatic-hydroaromatic structures as the dominant feature of most bituminous coals. The method allows the rapid recognition of coals of unusual chemical structure. 17 refs., 11 tabs.

29653 (DOE/PC/30224—5) **Coal structure and reactivity: the macromolecular structure of coal. Final report.** Larsen, J.W.; Green, T.K. (Tennessee Univ., Knoxville (USA). Dept. of Chemistry). Mar 1984. Contract FG22-80PC30224. 181p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE85013165.

Coals are considered to be three-dimensionally covalently crosslinked macromolecular networks. Solvent swelling techniques, modern polymer theories, and regular solution theory are applied to two bituminous coals in an effort to estimate their crosslink densities. The coals are observed to be extensively, internally hydrogen bonded. The hydrogen bonds serve as crosslinks between the macromolecular chains and contribute substantially to the structural integrity of the coals. Both coals obey the predictions of regular solution theory and their nonpolar solubility parameters are estimated to be 9.5 (cal/cm^3)/sup 1/2/. Flory interaction parameters were calculated for a series of nonpolar solvent-coal pairs. The Flory-Rehner and Kovac equations were then applied to the available data to estimate the crosslink densities of the coals. 124 refs., 37 figs., 27 tabs.

29654 (DOE/PC/40810—11) **Synthesis of oligomeric models of coal derived materials for use with GPC calibration. Quarterly report, October-December 1984.** Baltisberger, R.J.; Jones, M.B. (North Dakota Univ., Grand Forks (USA)). Dec 1984. Contract FG22-81PC40810. 12p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85009619.

Gel permeation chromatographic analyses have been performed for a series of acetylated solvent refined lignite (SRL) asphaltenes and preasphaltene samples, and model compounds. The data are consistent with a need for a size and shape correction based on aromatic condensation to be included in the calibration graph for the response of molecular weight with retention time. In order to test this hypothesis, a series of poly(vinyl)naphthalene oligomers have been synthesized for isolation into narrow molecular weight ranges by preparative GPC techniques. Poly(vinyl)naphthalene oligomers in the range 300 to 2000 g/mole have been synthesized. 2 figs.

29655 (DOE/PC/50801—10) **Laser induced coal fluorescence. Tenth quarterly technical progress report, January 1-March 31, 1985.** Borst, W.L. (Southern Illinois Univ., Carbondale (USA); Texas Tech Univ., Lubbock (USA)). 1985. Contract FG22-82PC50801. 20p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85012351.

The work performed during this period consisted of the completion of time resolved data acquisition and reduction of New Albany shale rank series, preliminary testing of a new deconvolution method, and the writing of additional software. The data acquisition consisted of 21 decay curves, one taken every 10nm over the fluorescence emission range of 450 to 650nm for each alginite maceral investigated. Approximately five alginite macerals were examined from each of the thirteen samples making a total of 61 macerals (1281 decay curves). The decay data were deconvoluted, resulting in decay times and percentages of fluorescing compounds as a function of wavelength. Because of the massive amount of data we are able to collect in a relatively short time and the fact that the current iterative deconvolution method requires a relatively large amount of time, it became imperative that a new deconvolution method be investigated. The new method was suggested by Dr. Robert Zitter, and, for the purpose of this report, is tentatively named the "Zitter Method." The software written during this period consisted primarily of additional data storage and presentation routines. 14 figs., 2 tabs.

29656 (DOE/PC/50807—T9) **Reaction calorimetry for coal chemistry and catalysis. Quarterly report, February 1, 1985-April 30, 1985.** Arnett, E.M. (Duke Univ., Durham, NC (USA). Dept. of Chemistry). 1985. Contract FG22-82PC50807. 17p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85010144.

Extension of the thermochemical approach to the study of hydrogen bond interactions on silica gel and its homogeneous analogue, triphenylsilanol, is presented here. This thermochemical study is analogous to that presented by R. Haaksma in previous reports (i.e., Annual Report August 1983 to July 1984). Heats of immersion were determined on the Setaram C-80 Tian-Calvet Calorimeter. While Haaksma used Dowex and p-toluene sulfonic acid as models for Broensted (proton transfer) processes in the thermochemical comparison, we are testing silica gel and triphenylsilanol as models for hydrogen bonding interactions. 9 refs., 3 figs., 5 tabs.

29657 **(DOE/PC/60785—7) Organic oxygen characterization of coal and coal liquids. Quarterly progress report, February-April 1985.** Ehmann, W.D.; Hamrin, C.E.; Koppenaal, D.W. (Kentucky Univ., Lexington (USA)). May 1985. Contract FG22-83PC60785. 26p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85012329.

Organically bound oxygen is one of the most abundant elements in coal, yet the amount and quality of data covering its abundance, mode of occurrence and processing behavior are relatively lean. The rectification of this problem will require the development of appropriate methods of oxygen determination which have been lacking in the past. The stature of coal science today demands a technique for organic oxygen determination other than the outdated and error-prone "oxygen-by-difference" calculation. This investigation addresses this need and intends to develop methods suitable not only for total organic oxygen determination, but also for determination of oxygen functionality. The methods and techniques developed will then be applied to practical needs in characterizing the oxygen geochemistry of coal and the evaluation of coal drying in solvents on liquefaction behavior. 9 refs., 3 figs., 8 tabs.

29658 **(DOE/PC/70006—T2) Enthalpy and phase behavior of coal derived liquid mixtures. Technical progress report, January-March 1985.** Yesavage, V.F.; Kidnay, A.J. (Colorado School of Mines, Golden (USA). Dept. of Chemical and Petroleum Refining Engineering). 30 Apr 1985. Contract FG22-84PC70006. 16p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85011199.

On July 15, 1984, work was initiated on a program to study the enthalpy and phase behavior of coal derived liquid model compound mixtures. During the third quarter modifications to both the calorimeter and the phase equilibria system were completed. The phase equilibria system was checked out against literature data for methanol/ethanol. Results of these tests are included in this report. The calorimeter was evaluated using previously confirmed heptane data and published data by Thinh, et al. These results are also reported. Initial calorimetry data have been obtained for tetralin and the data will be reported when the data set has been completed. 5 refs., 5 figs., 3 tabs.

29659 **(DOE/PC/70776—T3) Characterization of coal surfaces. Technical progress report, 5 February 1985-20 May 1985.** Fuerstenau, D.W. (California Univ., Berkeley (USA). Coll. of Engineering). Jun 1985. Contract FG22-84PC70776. 17p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85013149.

Estimates of γ/sub LC/, critical wetting surface tension, obtained with the film flotation technique were compared directly with results obtained with the immersion-time technique. Values for both raw and oxidized coals with the film flotation technique were in the range of 35 to 65 erg/cm^2 which is the range of values obtained by contact angle, freezing-front, and immersion-time methods. The film flotation and the potentiometric titration techniques were investigated in quantifying changes in coal surface properties due to oxidation. Coal susceptibility to oxidation was defined and correlated to coal properties. Low-temperature, low-pressure quinoline solubilization was found to be completely retarded by thermal oxidation. 24 refs., 4 figs., 5 tabs.

29660 **(EUR—9045-EN) Studies of the mechanical and chemical properties of coke at high temperature (Report on ECSC contract 7220-EB/818).** (Commission of the European Communities, Luxembourg). 1984. 74p. European Community Information Service, 2100 M St., NW, Suite 707, Washington, DC 20037.

An account is given of studies carried out on the properties of coke at high temperatures. The work consisted of two separate, but complimentary approaches, namely, the study of the resistance to breakage and abrasion of samples of coke tested in a refractory drum which could be heated to a temperature of 1450 C and a study of the dependence of the tensile strength of coke upon test temperature, heat treatment and with partial gasification of the coke, also at temperatures within the range of 1000-1400 C. The tests carried out in the high-temperature drum are described in Part 1 of the report and the effect of heat-treatment on coke tensile strength in part 2. (16 refs.)

29661 **(IFP—32-035) Study of size and structure of asphaltenes from crude oil by gel permeation chromatography.** Gourlaouen, C. (Institut Francais du Petrole (IFP), 92 - Rueil-Malmaison). Apr 1984. 199p. (In French). NTIS (US Sales Only), PC A09/MF A01. File Number DE85751219.

Polydispersion of asphaltenes is demonstrated by gel permeation chromatography. Global characterization of asphaltenes shows only an average of the different species. A detailed characterization requires a fractionation. Three asphaltenes (Boscan, Safaniya and Minas) were fractionated on a polystyrene gel column. On each fraction C, H, O, N, S, Ni and V content are determined. Molecular weights are determined by vapor pressure, osmotic pressure and light scattering at small angle, in the later case corrections are required because of fluorescence. Molecular weights range from 1500 to 100 000 and metal repartition is not homogeneous in all fractions. In the case of Boscan porphyrins were evidenced.

29662 (IS-EMRRI—19, pp 29-35) **Rapid dissolution of coal and minerals for analysis.** Kilpatrick, P.D.; Markuszewski, R. Dec 1983. NTIS, PC A07/MF A01. File Number DE85011356.

In Iowa State Mining and Mineral Resources Research Institute. Final report, July 1, 1982-September 30, 1983.

For many of the analytical methods employed for the determination of major, minor, and trace constituents in coal, the sample has to be first dissolved by a convenient and reliable method. Most dissolution methods are tedious and require unusual procedures. A rapid method for dissolving coal is being developed, based on digestion of a small coal sample with an acid mixture consisting of concentrated nitric, perchloric, and phosphoric acids. The resulting solution will be used for analyses by conventional spectrophotometric or other methods.

29663 **(NE-SBT—83-16) Importance of storage on peat quality.** Thoernqvist, T. (Naemnden foer Energiproduktionsforskning, Spanga (Sweden)). 1983. 28p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. File Number DE85750861.

In this pilot study, the effect of storage on peat quality has been studied. Three piles have been studied, each containing approximately 55 m^3 of peat. In one of the piles milled peat was stored which contained 15 percent water at the time the pile was laid up. The second pile consisted of sod peat with a moisture content of 41 percent. The third pile was peat which had been dewatered with the Multibelt method to moisture content of 77 percent. The storage period lasted from August 1982 until January 1983. The temperature in the Multibelt-dried peat pile was 5 to 10 C degrees above the surrounding area outside during the entire storage period. The temperature in this pile was registered at six measurement points. The average moisture content value increased in the pile with the milled peat up to 27 percent, and in the pile with the sod peat up to 44 percent. In the pile with the multibelt-dried peat the average moisture content did not change during the storage period. The dry substance loss, based on loss of organic material in nylon net sacks, was 1.3 percent in the milled peat pile, 2.9 percent in the sod peat pile and 0.8 percent in Multibelt-dried peat pile. Ash content increased in milled and sod peat from 1.3 percent to 1.7 percent, i.e., an increase of about 30 percent. In the Multibelt-dried peat, however, a reduction was noted in the ash content from 12.3 to 6.5 percent (about 47 percent ash content reduction). The dry peats efective heating value decreased during the storage period by 4.8 percent in the milled peat, and 5.2 percent in the sod peat. The heating value of the Multibelt-dried peat did not change the storage period.

29664 (NIPER—20, pp 287-298) **Thermophysical properties of real and synthetic fluid mixtures derived from fossil substances.** 28 Feb 1985. NTIS, PC A16/MF A01. File Number DE85000122.

In NIPER annual report, 1984.

Vapor-liquid-equilibria measurements and correlations were made on the following systems: hydrogen + water + tetralin at 542 K and to 24.06 MPa; tetralin + water at 541, 620, and 660 K and to 8.28 MPa; water + quinoline at 542 and 622 K and to 12.72 MPa; hydrogen + water + ammonia + tetralin + quinoline + 1-naphthol at 542 and 622 K and to 25 MPa; hydrogen + a cut boiling 450°-950°F from a thermal hydroliquefaction unit at 573, 623, and 673 K and to 2250 psia; and hydrogen + SRC II coal liquids. The results were used to show significant interactions between the polar and hydrogen species in fluids from coal and heavy ends of petroleum. The results also show that the chemical reaction of ammonia with phenolic compounds occurs readily, and processing of these materials can lead to significant production of carcinogens through such reactions. Efforts are currently being made to provide the needed data for the selection of a set of inspection properties to be used in predicting the energy requirements and the extent of separation in process phase separation units for coal liquids and liquids from heavy petroleum. The requirements for speed-of-sound data needed for the development of absolute calibration of gas flowmeters by sonic nozzles were established. Methane was selected for measurements to serve as a basic set in an integrated international effort to supply the required data, and the materials and instruments for the studies were prepared for the measurements.

29665 (SERI/CP—234-2506, pp 27-33) **Premium Coal Sample Program - a model.** Vorres, K.S. (Argonne National Lab., IL). Nov 1984. NTIS, PC A05/MF A01. File Number DE85006284. (CONF-8408106—Summ.). Contract W-31-109-ENG-38.

From Standards in biomass for energy and chemicals workshop; Gaithersburg, MD, USA (1 Aug 1984).

The Premium Coal Sample Program at the Argonne National Laboratory is intended to provide high quality, well characterized coal samples to the basic research community involved in coal studies. The overall goals are described, as well as the collection, transport, processing, analysis and distribution of the samples. Similarities and differences between coal and biomass samples will be discussed. A number of questions for processing which need to be considered are addressed.

29666 (STEV-TORV—84-6) **Classification of peat. An investigation of the physical properties of peat and the methods of determination.** Staffanson, H.; Fredriksson, D. (Statens Energiverk, Stockholm (Sweden)). 1984. 102p. (In Swedish). NTIS (US Sales Only), PC A06/MF A01. File Number DE85750863.

The project deals with the physical properties of natural peat. 149 samples of peat have been analysed. The samples represent the main types of peatlands (bogs, mixed mires and fens) and different peat types (sedge peat - sphagnum peat). The result shows that bulk density of peat can be predicted in field by using a wetness scale (B1-10) where B1-3 is dry peat, B4-6 normally wet peat and B7-10 is extremely wet peat. Bulk density can be measured in laboratory by using the pyknometer method with paraffin oil as liquid. Bulk density also has a high correlation towards water content. However, the measurements of the water content give too low values. Therefore, bulk density gets overestimated when using the water content/bulk density correlation. To get reliable values of bulk density it is necessary to take volume determined samples. The Russian centrifugal method (GOST 10650) for the determination of humification has been tested. The method gives a very weak correlation towards von Posts H-scale and also towards bulk density. The method, in its present stage, is not recommended for further analyses of the humifiction degree. It is concluded that bulk density is the most important factor to influence on the energy content per volume unit and that bogs/sphagnum peat contains in average 25 percent less energy per volume unit than fens/sedge peat. The difference is up to 80 percent due to the difference in bulk density and 20 percent due to lower heating value per weight.

29667 (VTT-TIED—391) **Coal characteristics.** Moilanen, A.; Aeijaelae, M. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). 1984. 331p. (In Finnish). Valtion Teknillinen Tutkimuskeskus, Espoo (Finland).

Data about coal characteristics have been gathered from the literature. The interdependence between coal characteristics are introduced. The characteristics depicting the degree of carbonization and correlations between other properties are primarily included. Factors depending on the degree of carbonization are primarily the carbon content of coal and the reflectance of vitrinite. Data about coal deposits in different countries (location, seams, general properties) are presented. The following characteristics of coal seams are presented; properties of economic significance (moisture, ash content, heat value); operating-technical properties (volatile substances, sulphur content, appearance of sulphur, grinding properties, chloride content, ash content and its melting behaviour); properties of environmental significance (microelement and heavy metal contents); chemical and structural characteristics (elemental analysis, petrographic properties); and cleaning-technical properties (ash composition, content of pyritic sulphur). (In Finnish)

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REFER ALSO TO CITATION(S) 30663, 31254, 31368, 31617, 31673

29668 (DOE/FE/60181—T1) **Catalytic activity of western coal fly ashes on the reduction of flue gas NO/sub x/.** Bobman, M.H.; Weber, G.F. (North Dakota Univ., Grand Forks (USA). Energy Research Center). 1985. Contract FC21-83FE60181. 16p. (CONF-850304—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004275.

From 7. international symposium on ash utilization; Orlando, FL, USA (4 Mar 1985).

The purpose of this investigation was to evaluate the use of fly ash to catalyze the reduction of NO/sub x/ by ammonia. A fixed-bed reactor through which simulated flue gas flowed at a rate of 0.5 scfm was operated to measure the catalytic activity of three low-rank coal-derived fly ashes. Also, a 130 scfm propane-fired combustor and high temperature baghouse were used to determine NO/sub x/ reduction. Results of these tests demonstrated a relationship between the temperature of reaction, fly ash composition, crystalline phases as identified by x-ray diffraction, and the level of NO/sub x/ reduction; the quantity and form of occurrence of iron in the ash was shown to dramatically influence fly ash catalytic activity. Conversion of NO/sub x/ catalyzed by fly ash was limited. Depending upon the outcome of federal legislation in the area of pollution abatement, the issue of NO/sub x/ emissions from large boilers may not be significant in the near term. Therefore, the applicability of marginally effective NO/sub x/ control methods may be of interest only after additional research has been completed to improve upon the technical and economic feasibility of flue gas NO/sub x/ control. If the regulatory environment changes in favor of flue gas NO/sub x/ treatment, one situation in which the fly ash material may benefit a utility is in the case of a combustor which generates an ash high in available hematite. 16 refs.

29669 (DOE/PC/60270—T1) **Acoustic agglomeration of power plant fly ash. Fourth quarterly report, June 8-September 7, 1984.** Reethof, G. (Pennsylvania State Univ., University Park (USA). Center for Air Environment Studies). 7 Dec 1984. Contract AC22-83PC60270. 42p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85004132.

Progress is reported on all four tasks of the work statement. The computer code for the simulation approach to the agglomeration process is now complete with the development of a fast and accurate numerical scheme. The hydrodynamic interaction of spherical aerosol particles in a high intensity acoustic field was completed. We showed that the refill process in one cycle can be explained by this process by adding Brownian movement and gravitational effects. The acoustic absorption studies at elevated temperatures are proceeding. The capacitive type sound source has been constructed. The required electronics is also complete. Delivery of the 1 in. internal diameter quartz tube is set for the mid-December period. The 700°F agglomerator system is now fully operational after testing phase. The current problem seeks to explain a consistent difference between the apparent mass loadings for the no-sound and the with-sound runs. Since sampling occurs in the center of the pipe it appears that acoustic streaming effects may be the cause of this phenomenon. In the next period we shall make measurements at various radial heights using this new capability of the system. A new cleaning system will reduce the uncertainty in the aerosol measurements. The high efficiency siren development is proceeding with receipt of the castings for the resonant air supply system, which are being machined. The bearings and the shaft seals have been received. Assembly will start in the next reporting period.

29670 (DOE/PC/60270—T2) **Acoustic agglomeration of power plant fly ash. Fifth quarterly report, September 8-December 7, 1984.** Reethof, G. (Pennsylvania State Univ., University Park (USA). Noise Control Lab.). 7 Dec 1984. Contract AC22-83PC60270. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85005215.

This quarterly report summarizes work accomplished on acoustic agglomeration of power plant fly ash. This includes: acoustic modeling, basic acoustic investigations, a 700°F agglomerator and the development of a high efficiency siren.

29671 (DOE/PETC/TR—85/7) **Evaluation of advanced separation techniques for application to flue gas cleanup processes for the simultaneous removal of sulfur dioxide and nitrogen oxides.** Walker, R.J.; Drummond, C.J.; Ekmann, J.M. (USDOE Pittsburgh Energy Technology Center, PA). Jun 1985. 101p. NTIS, PC A06/MF A01; GPO Dep. File Number DE85013006.

Thirteen advanced separation techniques were reviewed in detail for application to flue gas cleanup processes. Of these, the three most promising for application to systems for simultaneous removal of sulfur dioxide and nitrogen oxides from flue gas are solvent extraction, electrodialysis, and inverse thermal phase separation. Gas separation membranes would also be promising if a membrane could be developed that would be selective for SO_2 and NO/sub x/. Specific utility or industrial systems incorporating some of these processes are suggested. Preliminary estimates of annual revenue requirements for three gas-separation-membrane flue gas cleanup systems and an electrodialysis system are compared with an estimate for a limestone system with selective catalytic reduction. In addition, fourteen wet simultaneous SO_2/NO/sub x/ flue gas cleanup processes that have progressed beyond bench scale were reviewed for possible modification to incorporate advanced separation techniques. It appeared that in processes where modifications were possible, either such modification would result in marginal improvement, or the process would no longer be recognizable. 147 refs., 10 figs., 9 tabs.

29672 (KHM-TR—104) **Studies of foreign disposals for coal burning wastes.** (Statens Vattenfallsverk, Vaellingby (Sweden). Projekt KOL-HAELSA-MILJOE). Dec 1983. 162p. (In Swedish). NTIS (US Sales Only), PC A08/MF A01. File Number DE85750838.

This report consists of three parts. The first part is dealing with the design of landfills for coal burning wastes. It shows the experiences from fills in Denmark. Finland, Great Britain and USA. The second part is dealing with field investigations at Kollund, Denmark, where the ash from Ensted Power Plant is disposed, and the third part with investigations of profiles from coal ash disposal sites in England.

29673 (KHM-TR—104, pp vp) **Investigation of profiles from coal ash disposal sites.** Jacks, G. Dec 1983. (In Swedish). NTIS (US Sales Only), PC A08/MF A01.

In Studies of foreign disposal for coal burning wastes.

Coal ash disposal sites, 2 to 15 years old, have been investigated. Mosses colonialize uncovered sites after about 2 yers when the pH has gone down to 8-9 from the original value of about 11. By the action of CO_2 in the soil atmosphere, 1-2 percent $CaCO_3$ had been formed in the ash from CaO. Leachates from two of the profiles had pH of about 12. Molybdenum and arsenic, both present in form of anions, were found in elevated concentrations. Molybdenum in the ash is enriched in the grass turf on the top of the profile is likely to be leached out in the portion below. Arsenic in the ash is correlated to the contents of Fe_2O_3 and the leaching may be controlled by adsorption to ferric hydroxides. Gypsum has most likely been present in the profiles but has been leached out. The carbonatization of CaO is an important process that shortens the alkaline period in the disposal site and than than buffers the leachate at a pH of 8-9. The carbonatization ought to be favoured by means of covering the ash with soil as early as possible.

29674 (KHM-TR—104, pp vp) **Field investigations at Kollunds coal ash fill.** Meijer, J.E.; Malmkvist, P.; Svedberg, G. Dec 1983. (In Swedish). NTIS (US Sales Only), PC A08/MF A01.

In Studies of foreign disposal for coal burning wastes.

At Kollund in Denmark the ash from Ensted Power Plant is disposed. Here field investigations of the characteristics of coal ash and the disposal have been done. A separate investigation of ash dusting has been made. The coal ash is at Kollund deposited in a gravel pit. To collect leachate and surface water from the ash a plastic membrane has been laid to cover the bottom and sides of ash pit. After a 18 month period of ash disposal all water which has been collected has been used for preventing dusting. The surface of the fill is compacted from the lorries unloading the ash, While the sides are very loose. Under the compacted surface the ash also has less compaction. The temperature inside the fill is increased to about 40-50 C degrees. This probably has an influence on leachate formation. The moisture content of the ash has been investigated on different levels in the fill. The upper layers of the ash has an increase in the water content due to infiltration. This infiltration has been estimated to 22 and 29 percent of the precipitation at the two measuring points. The surface runoff from the fill has been collected and investigated. The water has been in contact with ash and has increased levels of sulphur, arsenic, molybdenum and chromium. The formation of dust is a problem at the ash outlet at the power plant. At the fill the dust content in air was low.

29675 (NP—5770295) **Briefing package: Low-pollution coal-fired power plants.** Folgmann, B. (Fachinformationszentrum Energie, Physik, Mathematik G.m.b.H., Bonn (Germany, F.R.). Buero Bonn). Sep 1984. 213p. (In German). NTIS (US Sales Only), PC A10/MF A01. File Number DE85770295.

The report presents power plant technologies permitting to use the primary energy source coal for power generation and save the environment at the same time. Subject divisions are processes for final flue gas purification (dust precipitation, flue gas desulfurization and denitrification) and new firing techniques, especially fluidized-bed combustion. Not only are the processes explained but plants are described as examples and experience reported as well. New power plant concepts for using coal in the power plant sector are also dealt with. The state of research and development is documented in a listing of the programmes promoted by the Federal Ministry of Science and Technology. A bibliography containing numerous titles of specific relevance permits readers to explore the subject in greater detail.

29676 (PB—85-175867/XAB) **Assessment of fluidized-bed-combustion solid wastes for land disposal. Volume 1. Final report. Report for June 1980-June 1984.** Grimshaw, T.W.; Minear, R.A.; Eklund, A.G.; Little, W.M.; Dunn, J.E. (Radian Corp., Austin, TX (USA); Arkansas Univ., Fayetteville (USA)). Feb 1985. 258p. NTIS, PC A12/MF A01.

See also Volume 2, PB85-175875; Prepared in cooperation with Arkansas Univ., Fayetteville.

This report, including 10 appendices, gives results of: (1) an analysis of representative samples of fluidized-bed-combustion (FBC) wastes, (2) an assessment of the characteristics of leachates generated from the wastes under laboratory and field (landfill) conditions, (3) a characterization of the attenuation of the leachates by earth materials that are typical of disposal settings, (4) development of a way to predict the leachate generation behavior of FBC wastes under landfill conditions on the basis of laboratory test results by establishing a rigorous statistical relationship between the laboratory and field-leaching results, and (5) assessment of the compatibility of commonly used landfill-liner materials with FBC waste leachates. FBC is an emerging energy technology that holds promise for both high efficiency of energy conversion and minimization of adverse air-quality impacts. A major advantage of FBC is that high-sulfur coal can be burned without the use of flue-gas desulfurization equipment to meet air-quality standards. The solid residues that are generated in an FBC unit are usually larger in volume and have different properties than the typical bottom ash from a conventional boiler.

29677 (PB—85-175875/XAB) Assessment of fluidized-bed-combustion solid wastes for land disposal. Volume 2. Appendices A through C. Final report, June 1980-June 1984. Little, W.M.; Gibson, T.S.; Grimshaw, T.W.; Eklund, A.G. (Radian Corp., Austin, TX (USA)). Feb 1985. 173p. NTIS, PC A08/MF A01.

See also Volume 1, PB85-175867 and Volume 3, PB85-175883.

This report Appendices A through C, gives results of: (1) an analysis of representative samples of fluidized-bed-combustion (FBC) wastes, (2) an assessment of the characteristics of leachates generated from the wastes under laboratory and field (landfill) conditions, (3) a characterization of the attenuation of the leachates by earth materials that are typical of disposal settings, (4) development of a way to predict the leachate generation behavior of FBC wastes under landfill conditions on the basis of laboratory test results by establishing a rigorous statistical relationship between the laboratory and field-leaching results, and (5) assessment of the compatibility of commonly used landfill-liner materials with FBC waste leachates. FBC is an emerging energy technology that holds promise for both high efficiency of energy conversion and minimization of adverse air-quality impacts. A major advantage of FBC is that high-sulfur coal can be burned without the use of flue-gas desulfurization equipment to meet air-quality standards. The solid residues that are generated in an FBC unit are usually larger in volume and have different properties than the typical bottom ash from a conventional boiler.

29678 (PB—85-175883/XAB) Assessment of fluidized-bed-combustion solid wastes for land disposal. Volume 3. Appendices D and E. Final report, June 1980-June 1984. Minear, R.A.; Grimshaw, T.W.; Little, W.M. (Radian Corp., Austin, TX (USA)). Feb 1985. 368p. NTIS, PC A16/MF A01.

See also Volume 2, PB85-175875 and Volume 4, PB85-175891.

This report, Appendices D and E, gives results of: (1) an analysis of representative samples of fluidized-bed-combustion (FBC) wastes, (2) an assessment of the characteristics of leachates generated from the wastes under laboratory and field (landfill) conditions, (3) a characterization of the attenuation of the leachates by earth materials that are typical of disposal settings, (4) development of a way to predict the leachate generation behavior of FBC wastes under landfill conditions on the basis of laboratory test results by establishing a rigorous statistical relationship between the laboratory and field-leaching results, and (5) assessment of the compatibility of commonly used landfill-liner materials with FBC waste leachates. FBC is an emerging energy technology that holds promise for both high efficiency of energy conversion and minimization of adverse air-quality impacts. A major advantage of FBC is that high-sulfur coal can be burned without the use of flue-gas desulfurization equipment to meet air-quality standards. The solid residues that are generated in an FBC unit are usually larger in volume and have different properties than the typical bottom ash from a conventional boiler.

29679 (PB—85-175891/XAB) Assessment of fluidized-bed-combustion solid wastes for land disposal. Volume 4. Appendix F. Final report, June 1980-June 1984. Eklund, A.G.; Grimshaw, T.W. (Radian Corp., Austin, TX (USA)). Feb 1985. 107p. NTIS, PC A06/MF A01.

See also Volume 3, PB85-175883, and Volume 5, PB85-175909.

This report, Appendix F, gives results of: (1) an analysis of representative samples of fluidized-bed-combustion (FBC) wastes, (2) an assessment of the characteristics of leachates generated from the wastes under laboratory and field (landfill) conditions, (3) a characterization of the attenuation of the leachates by earth materials that are typical of disposal settings, (4) development of a way to predict the leachate generation behavior of FBC wastes under landfill conditions on the basis of laboratory test results by establishing a rigorous statistical relationship between the laboratory and field-leaching results, and (5) assessment of the compatibility of commonly used landfill-liner materials with FBC waste leachates. FBC is an emerging energy technology that holds promise for both high efficiency of energy conversion and minimization of adverse air-quality impacts. A major advantage of FBC is that high-sulfur coal can be burned without the use of flue-gas desulfurization equipment to meet air-quality standards. The solid residues that are generated in an FBC unit are usually larger in volume and have different properties than the typical bottom ash from a conventional boiler.

29680 (PB—85-175909/XAB) Assessment of fluidized-bed-combustion solid wastes for land disposal. Volume 5. Appendix G. Final report, June 1980-June 1984. Williamson, H.J.; Grimshaw, T.W.; Dunn, J.E. (Radian Corp., Austin, TX (USA)). Feb 1985. 260p. NTIS, PC A12/MF A01.

See also Volume 4, PB85-175891 and Volume 6, PB85-175917; Prepared in cooperation with Arkansas Univ., Fayetteville.

This report, Appendix G, gives results of: (1) an analysis of representative samples of fluidized-bed-combustion (FBC) wastes, (2) an assessment of the characteristics of leachates generated from the wastes under laboratory and field (landfill) conditions, (3) a characterization of the attenuation of the leachates by earth materials that are typical of disposal settings, (4) development of a way to predict the leachate generation behavior of FBC wastes under landfill conditions on the basis of laboratory test results by establishing a rigorous statistical relationship between the laboratory and field-leaching results, and (5) assessment of the compatibility of commonly used landfill-liner materials with FBC waste leachates. FBC is an emerging energy technology that holds promise for both high efficiency of energy conversion and minimization of adverse air-quality impacts. A major advantage of FBC is that high-sulfur coal can be burned without the use of flue-gas desulfurization equipment to meet air-quality standards. The solid residues that are generated in an FBC unit are usually larger in volume and have different properties than the typical bottom ash from a conventional boiler.

29681 (PB—85-175917/XAB) Assessment of fluidized-bed-combustion solid wastes for land disposal. Volume 6. Appendix H. Final report, June 1980-June 1984. Williamson, H.J.; Heinrich, D.L.; Grimshaw, T.W. (Radian Corp., Austin, TX (USA)). Feb 1985. 123p. NTIS, PC A06/MF A01.

See also Volume 5, PB85-175909 and Volume 7, PB85-175925.

This report, Appendix H, gives results of: (1) an analysis of representative samples of fluidized-bed-combustion (FBC) wastes, (2) an assessment of the characteristics of leachates generated from the wastes underlaboratory and field (landfill) conditions, (3) a characterization of the attenuation of the leachates by earth materials that are typical of disposal settings, (4) development of a way to predict the leachate generation behavior of FBC wastes under landfill conditions on the basis of laboratory test results by establishing a rigorous statistical relationship between the laboratory and field-leaching results, and (5) assessment of the compatibility of commonly used landfill-liner materials with FBC waste leachates. FBC is an emerging energy technology that holds promise for both high efficiency of energy conversion and minimization of adverse air-quality impacts. A major advantage of FBC is that high-sulfur coal can be burned without the use of flue-gas desulfurization equipment to meet air-quality standards. The solid residues that are generated in an FBC unit are usually larger in volume and have different properties than the typical bottom ash from a conventional boiler.

29682 (PB—85-175925/XAB) Assessment of fluidized-bed-combustion solid wastes for land disposal. Volume 7. Appendix I. Final report, June 1980-June 1984. Eklund, A.G.; Grimshaw, T.W.; Minear, R.A. (Radian Corp., Austin, TX (USA)). Feb 1985. 144p. NTIS, PC A07/MF A01.

See also Volume 6, PB85-175917 and Volume 8, PB85-175933.

This report, Appendix 1, gives results of: (1) an analysis of representative samples of fluidized-bed-combustion (FBC) wastes, (2) an assessment of the characteristics of leachates generated from the wastes under laboratory and field (landfill) conditions, (3) a characterization of the attenuation of the leachates by earth materials that are typical of disposal settings, (4) development of a way to predict the leachate generation behavior of FBC wastes under landfill conditions on the basis of laboratory test results by establishing a rigorous statistical relationship between the laboratory and field-leaching results, and (5) assessment of the compatibility of commonly used landfill-liner materials with FBC waste leachates. FBC is an emerging energy technology that holds promise for both high efficiency of energy conversion and minimization of adverse air-quality impacts. A major advantage of FBC is that high-sulfur coal can be burned without the use of flue-gas desulfurization equipment to meet air-quality standards. The solid residues that are generated in an FBC unit are usually larger in volume and have different properties than the typical bottom ash from a conventional boiler.

29683 (PB—85-175933/XAB) **Assessment of fluidized-bed-combustion solid wastes for land disposal. Volume 8. Appendix J. Final report, June 1980-June 1984.** Williamson, H.J.; South, R.C.; Grimshaw, T.W. (Radian Corp., Austin, TX (USA)). Feb 1985. 314p. NTIS, PC A14/MF A01.

See also Volume 7, PB85-175925.

This report, Appendix J, gives results of: (1) an analysis of representative samples of fluidized-bed-combustion (FBC) wastes, (2) an assessment of the characteristics of leachates generated from the wastes under laboratory and field (landfill) conditions, (3) a characterization of the attenuation of the leachates by earth materials that are typical of disposal settings, (4) development of a way to predict the leachate generation behavior of FBC wastes under landfill conditions on the basis of laboratory test results by establishing a rigorous statistical relationship between the laboratory and field-leaching results, and (5) assessment of the compatibility of commonly used landfill-liner materials with FBC waste leachates. FBC is an emerging energy technology that holds promise for both high efficiency of energy conversion and minimization of adverse air-quality impacts. A major advantage of FBC is that high-sulfur coal can be burned without the use of flue-gas desulfurization equipment to meet air-quality standards. The solid residues that are generated in an FBC unit are usually larger in volume and have different properties than the typical bottom ash from a conventional boiler.

29684 (TNO-HMT-R—84-76) **Isolating fly ash adsorbed benz(a)anthracene-14 C and benzo(a)pyrene-14 C using liquid extraction.** Besemer, A.C.; Lems, T. (Nijverheidsorganisatie TNO, Delft (Netherlands). Hoofdgroep Maatschappelijke Technologie). May 1984. 16p. (In Dutch). Nijverheidsorganisatie TNO, Delt (Netherlands). Hoofdgroep Maatschappelijke Technologie.

Results are presented of a research program into the properties of fly ash with regard to the adsorption and desorption of polycyclic hydrocarbons. Benz(a)anthracene (with four rings) is adsorbed less than benzo(a)pyrene (with five rings). The composition of fly ash is also important. Results indicate that as the carbon content of the fly ash increases the adsorption increases too. The desorption behaviour, using with good results toluene and xylene, was investigated. The desorption of PAH is better with lower carbon content of the fly ash. (In Dutch)

29685 **Nitration of polycyclic aromatic hydrocarbons adsorbed to different carriers in a fluidized bed reactor.** Ramdahl, T.; Bjoerseth, A.; Lokensgard, D.M.; Pitts, J.N. Jr. (Central Institute for Industrial Research, Oslo, Norway). *Chemosphere;* **13**: No. 4, 527-534(1984). Contract AA03-76SF00034.

The reactivity of selected polycyclic aromatic hydrocarbons (PAH) adsorbed to various surfaces has been studied. PAH were adsorbed to silica, alumina or charcoal particles and exposed to ambient concentrations of NO_2 in air in a fluidized bed reactor. The reaction products were analyzed by capillary gas chromatography and gas chromatography/mass spectrometry. The results show that silica is a more reactive surface than alumina. The charcoal used showed to be very adsorbtive and too little material was recovered for analyses. The relevance of these results to the assessment of the possible formation of nitro-PAH in the atmosphere is discussed.

0109 Environmental Aspects

REFER ALSO TO CITATION(S) 29673, 29702, 29703, 29717, 29737, 32385

29686 (IMG-TNO-D—82) **Nuisance caused by (coal) dust coal storage facilities, an inventory and estimation.** Van Dongen, J.E.F. (Nijverheidsorganisatie TNO, Delft (Netherlands). Inst. voor Milieuhygiene en Gezondheidstechniek). Jul 1984. 31p. (In Dutch). Nijverheidsorganisatie TNO, Delft (Netherlands). Instituut voor Milieuhygiene en Gezondheidstechniek.

A dose-(annoyance) response relation with respect to coal dust cannot be developed yet. At best it can be concluded that, at the same deposition, black dust from coal, soot or fly ash causes annoyance sooner than any other kind of dust. However, some dose-response relations of other kinds of dust are available. Although from concentration and deposition measurements it appears that the dispersion of coal dust is limited to 1500 m, a conclusion that for those reasons problems of annoyance also will be limited is premature. Both on the doses side and the effect side intervening factors play a role, which have been insufficiently analyzed with respect to the annoyance. This concerns items such as the frequency of special weather conditions, the use of transport routes, emissions from other dust sources and occurrence of other environmental effects like noise. (In Dutch)

29687 **Emanation coefficients for Rn in sized coal fly ash.** Kalkwarf, D.R.; Jackson, P.O.; Kutt, J.C. (Pacific Northwest Lab., Richland, WA). *Health Physics;* **48**: No. 4, 429-436(Apr 1985). Contract AC06-76RL01830.

Emanation coefficients for ^{2}n^{22}Rn in sized samples of dry coal fly ash were evaluated as a function of source and particle size using a modification of the sealed-can, gamma-only technique. The emanation coefficient is defined as the fraction of Rn atoms that escape the solid particles of a source. Diffusible Rn was separated from non diffusible Rn by adsorption on charcoal, and each was measured independently by γ-ray spectrometry of the Rn daughter, ^{214}Bi. Samples of ash from eastern bituminous coal, western bituminous coal and mid-western bituminous coal with aerodynamic equivalent diameters of less than 15 μm were examined, and the measured emanation coefficients ranged from 0.098 down to 0.007. For unfractionated standard fly ash, SRM 1633a, from the US National Bureau of Standards, the emanation coefficient for ^{222}Rn was found to be 0.018. The results suggest that only a small fraction of the Rn in lung-deposited fly ash will be removed by exhalation.

29688 **Persistence of phenols in aquatic microcosms receiving chronic inputs of coal-derived oil.** Southworth, G.R.; Herbes, S.E.; Franco, P.J.; Giddings, J.M. (Oak Ridge National Lab., TN). *Water, Air, and Soil Pollution;* **24**: 283-296(1985). Contract AC05-84OR21400.

The environmental fate of constituent phenols of a coal-derived oil spilled intermittently on water was evaluated in aquatic microcosms. Phenols dissolved rapidly from the oil into the water, and initially accumulated with sequential oil additions. The major process removing phenols from the microcosms was microbial degradation - other processes were negligible in comparison. After phenols attained maximum concentrations in the first 28 days of the study, degradation rates exceeded input rates in all microcosms during the second 28 days the study and total phenol concentrations decreased. Significant differences were apparent in the rates of degradation of various alkylphenol isomers and isomer groups, but no compounds were observed to be refractory. Upon discontinuation of oil inputs at day 56, dissolved phenols disappeared within several weeks. Microcosm exposures history and the presence of other phenol isomers affected the rate of removal of individual isomers, complicating predicting of the rate of removal of individual toxicants.

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0110 Reserves And Exploration

REFER ALSO TO CITATION(S) 31137

29689 **(INIEX-FOL—6173) Geomechanical tests on rock samples from the KS 3 borehole (Dilsen).** van Duyse, H. (INTEX, Liege (Belgium)). Aug 1984. 16p. (In French). INIEX, Liege, Belgium.

For the purpose of investigating rock hardness in the coal strata north of Eisden workings, a series of geomechanical tests was conducted on cores of sandstone extracted from the KS 3 borehole at Dilsen. The tests sought to establish the following: uniaxial compression, traction, hardness, abrasiveness, quartz content and grain size, wear factor F and the texture and type of rock present. Gives details of how these factors were investigated (test equipment, types of drill bit used, etc.) and gives the results obtained, including the fact that the core samples revealed 18.8% sandstone - slightly more than in the Kempen coalfield. (In French)

29690 **(INIEX-FOL—6368) Geomechanical tests on rock samples extracted from the KS 9 and KS 12 boreholes.** van Duyse, H. (INTEX, Liege (Belgium)). Jul 1984. 6p. (In French). INIEX, Liege, Belgium.

The introduction of the Bouygues tunnelling machine at Zolder colliery was the reason for instigating a programme of compression and tensile tests on sandstone core samples extracted from boreholes KS 9 and KS 12 located to the north and north-east of the pit. The samples were restricted to rock strata which could be cut by the Bouygues machine. Describes the position of the boreholes and the samples taken. Concludes that the rock strength values obtained are lower than those measured from the KS 3 sandstone cores extracted at Dilsen. (In French)

29691 **(NP—4901587) Picture Butte coal project: a technical assessment of Picture Butte, 1983. [Final report].** (Associated Mining Consultants Ltd., Calgary, Alberta (Canada); Golder Associates, Calgary, Alberta (Canada)). Jun 1983. 150p. NTIS (US Sales Only), PC A07/MF A01. File Number DE84901587.

The observations and data obtained from the TMP at Kipp Mine, together with correlation of geotechnical data from that area and the limited geotechnical data from the Picture Butte area indicate the following: (1) Inseam physical characteristics and behavior of the coal and proximate roof and floor strata at Kipp indicate that with proper selection and application of today's coal mining technology, a longwall system of mining is possible at Picture Butte. (2) Main entries required for the long term should be driven as small as practicable and supported by arches complemented by roof bolts where required. The preferred direction of main entry driveage is south to north or north to south - the "weak roof" direction. (3) Service roadways for longwall retreat required for a short-term should be driven as narrow as possible, and rectangular in shape, in an east to west or west to east direction - the "good roof" direction. Roof bolts adjacent to the ribs of the retreat pillar of coal to be mined should be angled over the rib to help prevent roof fractures parallelling the rib line at or near the face, thereby reducing rock dilution of the coal. (4) Service roadways for longwall advance must be of the arch type, supported by rigid or yielding arches, these would also be driven in the "good roof" direction. Roadside packs of hardwood, anhydrite or aqua-packs can provide adequate roadway stability.

0120 Mining

REFER ALSO TO CITATION(S) 29689, 29690, 29734, 29740

29692 **(ACIRL-PR—84-18) Mine plan drafting.** Deakin, J.J.; Puckett, G.A. (Australian Coal Industry Research Labs. Ltd., North Ryde). Dec 1984. 65p. Australian Coal Industry Research Labs. Ltd., North Ryde.

This report describes the underground mine plan drafting system, MINDRAFT. The package was developed by Australian Coal Industry Research Laboratories Limited (ACIRL) as part of a five year research program which will result in a suite of underground mine planning software packages. MINDRAFT provides a graphics vehicle for the mine planning software which encompasses: automatic generation of different mine layouts; evaluation of layouts using varying production rates and resources; analysis of ventilation systems; stochastic simulation of underground mining processes, from the working face to the raw coal stockpile; and optimisation of longwall relocation times by use of critical path analysis. Although primarily a planning tool, MINDRAFT is beneficial in an operational sense, being used for colliery plan production and conversion between grid co-ordinate systems. (20 refs.)

29693 **(CSIRO-DG-GCM—57) Physical model study of caving under massive sandstone roof conditions at Moura, Queensland.** Wold, M.B. (Commonwealth Scientific and Industrial Research Organization, Mount Waverley (Australia). Div. of Geomechanics). 1984. 68p. CSIRO, Division of Geomechanics, Mount Waverley, Australia.

A physical model of the region at the Theiss Dampier Mitsui mine, Moura, Queensland, for which longwall mining is under consideration was constructed to a scale of 1:150. The model represented a vertical slice from -100 m to -300 m in depth and about 200 m in the ENE-WSW direction, and was loaded biaxially to simulate the in situ rock stress conditions. The mechanical, structural and lithological features of the rock mass were modelled using specially developed low strength materials which satisfied the necessary scaling requirements. The model contained in excess of 8000 blocks, representing in situ blocks ranging in size from 1 m x 2 m to 2 m x 4 m. Portions of two coal seams were progressively mined from the model while loads were measured on an instrumented model longwall support. Roof caving and goaf formation mechanisms were recorded and measured using high precision photogrammetry. The model provided data on caving spans, bulking factor, caving height, angle of break, support loads, and the influence of structural geology and horizontal stress. (7 refs.)

29694 **(CSIRO-DG-GCM—58) Research for deep opencast coal mines - European practice.** Dunbavan, M. (Commonwealth Scientific and Industrial Research Organization, Mount Waverley (Australia). Div. of Geomechanics). Sep 1984. 23p. CSIRO, Division of Geomechanics, Mount Waverley, Australia.

Geotechnical research in the European surface coal mining industry is based chiefly on problems arising from the effect of mining on the land surface and groundwater in the vicinity of the mine site. The level of activity is low compared with geotechnical research for civil engineering projects and nuclear waste disposal. Some of the geotechnical analyses and instruments developed for civil engineering applications could be applied in geotechnical investigations at surface coal mines. The geological and environmental conditions associated with surface black coal mining differ significantly between Europe and Australia. Thus, surface mining technology developed in Europe should not be accepted in Australia unless an adequate geotechnical review of its suitability is undertaken. Mining conditions in brown coal deposits are similar for Europe and Australia and much of the mining technology, especially that developed by the Rheinbraun company, could be adapted for Australian mines. The higher operating costs of European mines and the more difficult mining conditions mean that mine operators keep a close account of the cost of pit wall instability. The operating conditions in Australian surface coal mines make similar economic analyses of pit wall instability impractical. However, the introduction of different mining methods in future mines and a more competitive world market for coal should prompt operators of Australian mines to adopt regular systematic pit wall surveillance methods as part of their assessment of overall operating costs. Early detection of pit wall instability would help in the reduction of the impact of slope movement on coal mining in the most cost-effective way. (12 refs.)

29695 **(DOE/MC/20184—1829) Evaluation of in-place gas, reserves and production potential of coalbed gas using a vertical boreholes pattern. Final report, September 1, 1983-December 31, 1984.** Al-Saadoon, F.T. (Texas A and I Univ., Kingsville (USA). Dept. of Chemical and Natural Gas). May 1985. Contract AC21-83MC20184. 38p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85011388.

The primary objective of this study was to evaluate in-place gas, reserves and production potential of coalbed gas using a vertical boreholes pattern. The DOE-US Steel project in the Warrior Basin is selected as a specific site analysis because of the abundance of data, including 7 years of production history, available on the project. Three models were developed for the implementation of the preceding objectives. The first model is based on the extension of the production decline curve method, the second model is based on the extension of the volumetric method, and the third model is based on the material balance method. The Gas Research Institute Mathematical Model, designated WELL2D, was tried to implement solutions for the two-dimensional (areal) flow-field associated with the transport of gas and water through a vertical, finite-conductivity fracture to a vertical well. This effort had the objective of validating the model through history matching and then of predicting the future performance of the coalbed seam. This effort was unsuccessful. During the 89-months period it has been reported that the cumulative gas production from the 23-well pattern is 2.31 billion scf. That is, about 87% of the original gas in place has been produced in less than 7 1/2 years. 4 figs., 6 tabs.

29696 (INIEX-FOL—6074) **Cracking in concrete support panels due to the force exerted by the thrust pads of a Bouygues tunnelling machine.** van Duyse, H. (INTEX, Liege (Belgium)). Nov 1983. 21p. (In French). INIEX, Liege, Belgium.

This paper explains the background to the problem: the force exerted by the thrust pads of the tunnelling machine can produce cracks in the support panels, particularly when there are cavities between the panels and the rock walls. Describes the arrangement of the thrust pads and panels in some detail and goes on to present the test apparatus devised for an investigation of the problem. Interprets the findings from the seven test runs and concludes that while the cracks never affected the inner surface of the panels, it would prove beneficial to affix a yielding plastic sheet to the pads (as practised on the tunnelling machine at Cadley Hill colliery) in order to prevent load concentration when the cavity between panels and rock lies eccentric to the thrust pad. (In French)

29697 (INIEX-FOL—6377) **Tests on reinforced concrete blocks with embedded inserts.** van Duyse, H. (INTEX, Liege (Belgium)). Aug 1984. 56p. (In French). INIEX, Liege, Belgium.

Due to the success achieved with concrete roadway panels with embedded inserts, Beringen colliery decided to order a second batch for the lining of some 100 m of circular stone-drift. Describes the tests undertaken with concrete blocks having different types of reinforcement. Describes the panels used for the underground trials and the blocks tested in the laboratory. Give details of the compressible inserts (composite wood/wood fibre), the type of reinforcement, the test method and the results obtained (total of 10 blocks tested). Presents an interpretation of the test findings. Gives numerous figures showing the reinforcement structure, the development of fissures and deformation for different types of reinforcement, etc. (In French)

29698 (INIEX-FOL—6378) **All-weather storage of compressible inserts as fixed to reinforced concrete roadway panels.** van Duyse, H. (INTEX, Liege (Belgium)). Aug 1984. 3p. (In French). INIEX, Liege, Belgium.

This report explains the background to the investigation: the increasing degree of mechanisation in the placing of concrete support panels has created a demand for the compressible inserts to be glued in place on the panels. Open-air storage of the 40 mm-thick inserts was a problem which had to be investigated. Examines the weathering ability of the inserts over various periods and how this affected the two types of adhesive used (swelling rate, etc.). Concludes that phenolic adhesive is more suitable in view of the length of open-air storage involved. (In French)

29699 (INIEX-FOL—6379) **Compressive tests on Bullflex bags with different filler materials.** van Duyse, H. (INTEX, Liege (Belgium)). Aug 1984. 22p. (In French). INIEX, Liege, Belgium.

The principal aim of the tests was to assess the behaviour of Bullflex bags, filled with a variety of materials, when inserted in large-volume cavities behind reinforced concrete panels and at the same level as the thrust pads of the tunnelling machine. A second objective was to evaluate the compressive strength of different filler products. Describes the test set-up, the position of the tunnelling machine, the application of stress forces, etc. and lists the nine types of fill product used (synthetic anhydrite, limestone/cement mixes, LIC/grout 66, natural anhydrite, etc.). Presents the test findings and also describes the rupture tests carried out on the Bullflex bags. Discusses the advantages of Bullflex for circular-panel and circular-arch lined roadways and for cavity filling. Includes an assessment of the costs involved. (In French)

29700 (INIEX-FOL—6380) **Behaviour of an initial section of circular stone-drift lined with concrete panels featuring embedded inserts.** van Duyse, H.; van Espen, R. (INTEX, Liege (Belgium)). Aug 1984. 20p. (In French). INIEX, Liege, Belgium.

This report discusses the stability of a 50 m-long section of circular stone-drift which is supported by concrete panels with embedded compressible inserts. Describes the construction of the panels, their dimensions, the layout of the reinforcing bars, the method used for implanting the inserts and the reasons for the choice of the test site. Includes details of stress and deformation measurements in the roadway together with the results of underground observations. Discusses the merits of the compressible-insert method and emphasizes the importance of filling the cavity between the lining panels and the surrounding rock wall. (In French)

29701 (IS-EMRRI—19) **Iowa State Mining and Mineral Resources Research Institute. Final report, July 1, 1982-September 30, 1983.** (Iowa State Univ. of Science and Technology, Ames (USA). Energy and Mineral Resources Research Inst.). Dec 1983. Contract W-7405-ENG-82. 128p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE85011356.

The Iowa State Mining and Mineral Resources Research Institute (ISMMRRI) conducts technical research of a substantive nature directed at solving near, intermediate, and long term problems in the development of mineral extraction, characterization, and processing. These activities are supported with funds provided by the Bureau of Mines, US Department of the Interior, under Sections 301 and 302 of Title III, P.L. 95-87, the Surface Mining Control and Reclamation Act of 1977. Technical projects focused on mineral extraction and characterization techniques have been pursued. Several of our current projects addressing impacts of mineral waste management have drawn to a close in the past months as final data have been compiled and analyzed. Some of the promising current projects have addressed better ways to mineral characterization and analysis and have predicted mineral behavior during processing. Other projects have addressed the improvement of mineral processing techniques. Methods of characterization and processing have been tested in laboratory-scale experiments. Further experiments in these areas are being conducted to verify and expand our current data bank. In addition, apparatuses have been developed and field-tested to improve the quality of measuring stresses and testing rock strength in underground mine workings. 9 projects have been entered individually into EDB and ERA.

29702 (IS-EMRRI—19, pp 69-81) **Effects of reclamation methods on groundwater quality and resaturation rates.** Galloway, K.; Lemish, J. Dec 1983. NTIS, PC A07/MF A01. File Number DE85011356.

In Iowa State Mining and Mineral Resources Research Institute. Final report, July 1, 1982-September 30, 1983.

Statistical analysis indicates that groundwater quality on the Iowa Coal Project Demonstration Mine is significantly better than that on the Star Mine for nine of the twelve constituents measured. This quality difference is probably due to differences in mining and reclamation techniques and length of time the spoil was exposed. The ICPDM was mined and reclaimed with scrapers, and reclaimed concurrently, which reduced the amount of time the pyritic material was exposed. The Star Mine, however, was mined and reclaimed primarily by dragline and reclaimed minimally. In addition, the Star Mine was open longer increasing the length of time of oxidation.

29703 (IS-EMRRI—19, pp 87-89) **Effect of nitrogen-fixing growth on restored coal spoil banks.** Kean, J.N.; Schultz, R.C. Dec 1983. NTIS, PC A07/MF A01. File Number DE85011356.

In Iowa State Mining and Mineral Resources Research Institute. Final report, July 1, 1982-September 30, 1983.

Inoculation with mycorrhizal fungi has been shown to improve the establishment of seedlings. This hypothesis is being tested with various kinds of stock by inoculating half of them and leaving the other uninoculated. If natural inoculum exists on the site all seedlings should eventually become mycorrhizal but those that become infected earliest should have greater survival and growth advantage. Since the initial survival is dependent to a large extent on the timing of new root growth and top growth, phenological measurements are being made at regular intervals during the first two growing seasons. Roots systems will be excavated and root development will be related to soil profile characteristics. To date, nearly 63% of the trees planted earlier this year are surviving and are likely to last the duration of the research project. Efforts are underway to distinguish the effects of inoculation with mycorrhizal fungi on the various plots of seedlings.

29704 **(LBL—19552) Characterization of respirable coal mine dust.** Pryor, C.J. (Lawrence Berkeley Lab., CA (USA)). May 1985. Contract AC03-76SF00098. 49p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85013184.

Characterization of coal mine dust was done by thermal evolved gas analysis (EGA), x-ray photoelectron spectroscopy (XPS or ESCA), and scanning electron microscopy (SEM). These analyses were done to determine the chemical, physical, and morphological characteristics of coal mine dust, especially in regard to the differences among dust of differing sources and the changes occurring as these particles are exposed to the atmosphere. The EGA thermograms gave information pertaining to the amount of carbon, hydrogen, and nitrogen evolved from the sample. The CO_2 thermograms of coal dust samples showed that carbon was evolved in two components with different combustion temperatures. The H_2O thermograms showed that hydrogen was evolved concurrently with carbon. The NO/sub x/ thermograms showed that nitrogen was associated with the "aromatic" carbon. ESCA results for laboratory-generated samples showed that coal dust particles contain carbon, oxygen, nitrogen, and sulfur. ESCA was also useful in differentiating between a series of samples from the same mine. The major difference occurred in the C 1s spectra. SEM results of laboratory-generated samples determined the morphology and size distribution of coal dust particles. SEM showed that particles of dust are in the respirable range with some ranging down to the submicron level. The morphology of coal dust particles showed fractured planes with angular shapes. 36 refs., 14 figs., 5 tabs.

29705 **(NP—5750834) Delme project. Final report.** (Swedish State Power Board, Vaellingby). Jan 1984. 86p. (In Swedish). NTIS (US Sales Only), PC A05/MF A01. File Number DE85750834.

This report describes a peat mining machine called Torvex XIII, and the properties of the sod peat mined using this so called Delme-method. The peat is treated with a high speed rotating blade which as a result produces peat with a higher content of fine particles than other mining machinery. According to the tests, only 4 percent of the plant structures remain after the treatment. Comparative tests, showed that the Torvex produced peat is drying slower, but more resistant to rewetting and has a higher energy content. The tests show that Torvex can produce sod peat from low-humificated peat. Production figures of 60 m^3 raw peat/h can be reached. The blade is sensitive to stone, metal objects and hard stumps in the bog. The machine is rather expensive, has a larger turning radius and can only be used for peat production, but is still believed to be competitive to other peat mining.

29706 **(STEV-TORV—83-8) Machine system Rejlers for peat production.** Aution, A. (Statens Energiverk, Stockholm (Sweden)). Jun 1983. 36p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. File Number DE85750864.

Final report.

The possiblities to use automated mining techniques for mining peat are studied, i.e. remote control of the mining vehicle with automatic positioning using microcomputers and radar guidance. Using such systems it is estimated that one operator can control three mining vehicles.

29707 **(STEV-TORV—84-3) Full depth method for peat mining. Stage 2.** Tunbraa, L.O. (Statens Energiverk, Stockholm (Sweden)). Jan 1984. 50p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. File Number DE85750844.

The project aims to develop a method to mine peat utilizing conventional contracting machines. After limited mechanical dewatering the drying is made by wind and sun. In this second stage the different parts of the system have been tested in close to full-scale during natural winter conditions. The tests have shown that it is possible to harvest and haul the peat from the surface of the frozen bog without difficulties and with the capacity aimed to, 18000 metric tons dry substance per year by a dry substance dgree of 10 percent in the bog. The further preparation of the peat has indicated that it is possible to dewater the peat to a dry substance content of appr. 20 percent. To achieve this with satifying capacity and economy further development of the equipment is necessary. The equipment for stacking the peat should also be further developed to provide for a higher capacity. The cost of production of peat by the Full-depth-method is calculated to 285 SEK per metric ton of dry substance.

29708 **(STEV-TORV—84-9) System IUC. Optimization of milled peat production.** Larsson, B.; Karlsson, Aa.; Wiksten, L. (Statens Energiverk, Stockholm (Sweden)). May 1984. 62p. (In Swedish). (IUC—1). NTIS (US Sales Only), PC A04/MF A01. File Number DE85750867.

Efficient methods and equipment for production of milled peat are examined in this report. Cost estimates are presented for peat production at a bog exploited by a utility at Skellefteaa in northern Sweden.

29709 **Research on ground stability in underground coal mining.** Markley, R.W. pp 619-629 of Stability in underground mining. Brawner, C.O. (ed.). New York, NY; Society of Mining Engineers of the American Institute of Mining, Metallurgical and Petroleum Engineers (1983). (CONF-820826—).

From 1. international conference on stability in underground mining; Vancouver, BC, Canada (16 Aug 1982).

The predominant methods for mining coal in the USA are room and pillar and longwall. Approximately 95 percent of the coal is mined by room and pillar and 5 percent by longwall. The US Department of Energy (DOE) has an ongoing program to improve the rate, quality, and cost effectiveness of stabilizing the roof for both of these mining systems. In room and pillar mining, the installation of permanent roof support is often the task which paces the system operation, and it thus controls the level of production achieved during any mining shift. Two automatic roof bolt insertion equipment developments are discussed, as well as a flexible drill for operation in thinner seams. Progress will be reported on underground trials of a particular flexible drill which has been combined with a bolt inserter to form a compact, reliable module for retrofitting to continuous mining machines. In longwall mining, the use of hydraulic supports on the working face provides roof stability. The DOE has several trials ongoing with shield-type supports in difficult strata conditions which are described, as well as a cofunded project with the Bureau of Mines on a resin injection remedial method for consolidating a shear zone at one site. A project to improve the match of strata conditions to shield design is also described, which involves the use of a 1360 tonne vertical load mine roof simulator.

29710 **(SMRE-Trans—7253) Geological origins in the prognosis of gas-bearing qualities in coal-bearing strata for the purpose of solving the problems of gas hazard in mine workings.** Zimakov, B.M. (Health and Safety Executive, London (UK)). Sep 1977. Translation source information not available . (HSE-Trans—7253). 21p. NTIS (US Sales Only), PC A02. File Number DE85901522.

The construction of large mines, at deeper levels and with greater intensification of extraction working due to the introduction

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of high-output machines and high-speed extraction technology, have led to a sharp increase in the level of methane in mine workings, which has a negative effect on the safety of underground work and mine productivity. An important role in maintaining safety during the exploitation of gas-bearing deposits of solid mineral fuels is played by the geological service, whose duties include supplying and the planning organisations with source materials for assessment of the predictable levels and types of gas discharge, so that preliminary measures may be developed at the planning stage to counter gas discharges. Construction and re-construction planning in modern mines is impossible without this geological material on the gas bearing qualities of coal seams and a prognosis of methane levels in the mine workings. The levels of predictable discharges of mine gas in the workings predetermines the cross-section of the main air-channeling drifts, and the parameters of the main fan installations; the necessity of controlling gas discharges in mines affects the choice of extraction systems, the plan for ventilation and industrial degassing of seams, the control of roofs, and the suitability of the extraction of neighbouring seams. The source data for the prognosis of methane intensity in future mines are the results of surveys of coal deposits. The methane intensity in mines being newly constructed, or undergoing fundamental reconstruction, is calculated by the methane-bearing qualities of the coal seams, subject to the standard documents. 3 refs., 3 tabs.

29711 **(SMRE-Trans—7255) Methane emission in workings and some characteristic gas conditions in a brown coal mine.** Minchev, M.; Markov, K.; Nanovska, S. (Health and Safety Executive, London (UK)). Sep 1977. Translation source information not available . (CONF-7710198—14-Trans.; HSE-Trans—7255). 15p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85901524.

From 17. international conference of mining safety research; Varna, Bulgaria (3 Oct 1977).

The results of the investigation permit the following assertions to be made: in all the development workings there are aerodynamic conditions favourable for the formation of methane layers; that is, the mean velocity of the ventilation flow is usually within the limits 0.15 to 0.30 m/s, and the velocity profiles are characterised by maximum velocities at the floors - sources of methane, forming layers, are usually at a distance of 15-20 to 30-35 m from the face or at the intersections of minor geological disturbance - faults, etc. The intensity of these sources is of the order of 0.2 to 0.5 m^3/min - methane layers are extremely stable and depending on the behavior of the source endure for several weeks, months and in some cases for the whole period of the development of the workings. At the junction of faces with the ventilation roadway, there are regions of complex gassy conditions, manifested by the formation of local pockets of methane and where, in the majority of cases, these is a dangerous explosive concentration of methane. Methane generated from the goaf enters the ventilation flow in the last 5 to 10 m of the face and usually directly into the ventilation roadway. During gas generation in excess of 0.5 to 0.6 m^3/min from the goaf, accumulations higher than 2% are established, and when the gas generation is higher than 1.0 m^3/min, explosively dangerous concentrations higher than 5% can occur. Pockets with methane content higher than 2% have a length of order 7 to 10 m, and with a content higher than 5% have a length of order 3.5 m depending on the aerodynamics at the junction. The thickness of the gas pocket is extremely variable and usually varies within the limits 15-20 to 30-40 cm.

29712 **(SMRE-Trans—6173) Test report for linings for couplings and brakes for use in mining machines for surface and underground workings in which there is assumed to be a fire or explosion hazard due to the possible occurrence of methane/or coal dust/air mixtures.** (Safety in Mines Research Establishment, Sheffield (UK)). Jul 1972. Translation source information not available . 49p. NTIS (US Sales Only), PC A03. File Number DE85901521.

Tests of 5 different brakelinings for ignition at extreme working conditions are reported. (LTN)

0130 Transport And Handling

REFER ALSO TO CITATION(S) 29657, 29663, 29701

29713 **(DOE/PC/50270—T6) Coal water mixture development. Quarterly technical progress report, first quarter 1985.** (TRW Space and Technology Group, Redondo Beach, CA (USA)). 1985. Contract AC22-82PC50270. 25p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85012301.

The first run in the long-term testing phase of the program began January 9, 1985. The purpose of the long-term test phase is to obtain data useful for evaluating the long-term performance of plant equipment, instrumentation, pipe and pipe components in CWM service that performed acceptably during screening test operations. The components being evaluated are those which performed according to engineering design specifications in conjunction with no gross failures directly attributable to CWM service. Thirteen runs were completed during this reporting period. Eleven hundred and seventy-nine hours of equipment performance data were generated using "reference slurry" from the first two shipments produced by Vendor C. Data reduction and evaluation for Slurry No. 5 of the Screening Test Phase were completed. The hydraulic data obtained from tests with this slurry are included in this report. 11 figs., 1 tab.

29714 **(DOE/PC/60789—2) Development and testing of a novel mechanical device for dewatering peat. Quarterly technical progress report, 1 July-30 September 1984.** (Institute of Gas Technology, Chicago, IL (USA)). May 1985. Contract AC22-83PC60789. 10p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85012350.

The Internal Rotary Compression (IRC) system concept is suggested by Anderson Metal Industries, Inc. This system has the following potential advantages over current mechanical dewatering devices: (1) Improved peat dewatering achievable due to its ability to apply, simultaneously, compression and shear forces to peat between nonporous surfaces of rolls; (2) reduced unit cost due to small size because rolling surfaces are internal; (3) field-portability permitted by the compactness of the unit reduces operating costs; and (4) a no-slip entry of peat to the pinch area permits gradual compression and maintains unit compactness. In Phase I a bench-scale IRC press was designed, fabricated, and tested. The results obtained from testing the bench-scale IRC press (3-inch diam. outer roll and 2-inch diam. inner roll) have demonstrated that the IRC press can mechanically dewater peat to less than 50 wt % moisture. Approval to begin Phase II of the program was received in July 1984. In this Phase a prototype IRC press (3-ft diam. outer roll and 2-ft diam. inner roll) capable of producing at least 50 lb/h of dewatered peat will be designed and constructed at AMI. The press will be tested at IGT in Chicago to determine the effects of operating conditions on the quality and production rate of dewatered peat. During this first quarter the design criteria for the unit was finalized. All designs and blueprints for the unit have been completed. Preliminary evaluation of the solids feed and retrieval systems have been made. 2 figs.

29715 **(DOE/PC/70796—3) Effect of maceral properties on the comminution of coal. Technical progress report, January 1-March 31, 1985.** Bodily, D.M. (Utah Univ., Salt Lake City (USA). Dept. of Fuels Engineering). 1985. Contract FG22-84PC70796. 3p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85010822.

The swelling of four Utah coals in various solvents of different solubility parameters were measured. The results are listed in Table 1. The samples show swelling up to 50%. The solvents which cause large swelling also extract organic material as evidenced by discoloration of the solvent. No major differences in the swelling properties of the four coals were observed. The coals are all of similar rank, but do show differences in their ease of flotation and in their catalytic hydrogenolysis reactivity. The swelling behavior appears to be more dependent on the chemical properties of the solvent than on the nature of the coal. Four samples from the Pennsylvania State University Coal Sample Bank were separated by the analytical density gradient centrifugation procedure. Hiawatha, Utah coal was selected for studies of induced porosity by freeze drying coals swollen in solvent. The coal was dried and swollen by methanol. Surface areas were measured by CO_2 adsorption at -78°C. The untreated coal showed a surface area of 335 m^2/g. A sample which was swollen with methanol and the methanol removed at 25°C showed a surface area of 226 m^2/g. A sample which was swollen with methanol and the methanol removed at -78°C showed a surface area of 168 m^2/g. The melting point of methanol is -97°C. It was expected that the swollen pore structure might be retained by removing the solvent at low temperatures. 1 ref., 1 tab.

29716 (IS-EMRRI—19, pp 43-64) **Dewatering of coal sludge by pressurized electroosmosis.** Heath, L.W.; Demirel, T. Dec 1983. NTIS, PC A07/MF A01. File Number DE85011356.

In Iowa State Mining and Mineral Resources Research Institute. Final report, July 1, 1982-September 30, 1983.

This investigation showed that electroosmosis can be successfully used to enhance the dewatering of coal sludge. In general, higher voltage gradients led to lower final moisture contents in a shorter time, but at the expense of higher energy consumption. In addition, lower initial moisture contents produced sludges with lower final moisture contents independently of the voltage gradient. In dewatering coal sludge solely by electroosmosis, it was found that the sludge failed to consolidate continually, causing an unsaturated state to develop and heating subsequently occurred. In addition to heating, energy was consumed by electrochemical reactions apparent by the precipitation of calcite in the removed water. The investigation also showed that by combining electrical and hydraulic gradients, lower final moisture contents were obtainable in a much shorter time and that the final moisture content produced by combined gradients was lower than that produced by the gradients individualistically. It was found that when combined, hydraulic dewatering predominated initially and once ceased, electroosmosis continued to dewater the coal sludge. Also, due to the shorter time and higher degree of consolidation produced by the combined ingredients, heating and electrochemical reactions were not as significant.

29717 (IS-EMRRI—19, pp 83-85) **Ground water quality of municipal aquifers downstream from a coal preparation plant.** Osolin, R.L.; Lemish, J. Dec 1983. NTIS, PC A07/MF A01. File Number DE85011356.

In Iowa State Mining and Mineral Resources Research Institute. Final report, July 1, 1982-September 30, 1983.

To date, analyses of collected samples show increased concentrations of sulfate, calcium, iron, and manganese near the beneficiation plant as compared to those found during the original baseline study. Currently, these increases are confined to the shallow ground water beneath the site and have not extended much either laterally or vertically. Monitoring also indicates that the water quality has been nearly stable for the past two years, demonstrating no progressive deterioration. The concentration of contaminants found in the ground water at the site is low as compared to the ranges reported for similar coal storage sites throughout the nation. Analysis of surface water samples also indicates that the receiving streams are able to dilute the surface run-off from the beneficiation plant area to acceptable levels.

0140 Combustion

REFER ALSO TO CITATION(S) 29740, 31324, 31339, 31340, 31344, 31401

29718 **(AD-A—150532/0/XAB) Initial assessment of coal-fired ship operations. Final report.** Baham, G.J. (Baham Corp., Columbia, MD (USA)). Nov 1984. 54p. NTIS, PC A04/MF A01.

This report summarizes recent operational experience of a new generation of ocean-going coal-fired ships. The experience summarized in this report is based upon direct discussions with shipowners, operators, and shipyard as well as data published in the literature. The owners and operators of seven of these new ships give a positive endorsement to the feasibility of coal-fired steam propulsion. They all have had startup problems which will require retrofits to correct. These problems have mainly been with obtaining consistent fuel quality, coal transfer, and ash-handling system operations. In time the operational problems with coal- and ash-handling systems will be resolved through better design and application. The best solution for resolving the coal fuel-quality problems may lie in the development and application of fluidized-bed combustion to marine propulsion. There has been no major loss of revenue or time delays as a result of the problems and all owners indicate they would select coal-firing for future ships in the same trades.

29719 **(DOE/MC/20182—T1) Coal-water mixtures combustion modeling. Final report, 6 May 1983-6 August 1984.** Smith, P.J.; Fletcher, T.H.; Baxter, L.L.; Smoot, L.D. (Brigham Young Univ., Provo, UT (USA). Dept. of Chemical Engineering). 31 Jan 1985. Contract AC21-83MC20182. 116p. NTIS, PC A06/MF A01; GPO Dep. File Number DE85011488.

The objectives of this study were to develop, evaluate and implement a computer model for describing the combustion of coal-water mixtures for gas turbine applications. This program is intended to assist METC in demonstrating the viability of CWM use in gas turbines, and in understanding and predicting the formation of products of combustion. The study has five tasks; (1) reporting of information and implementing the resulting computer code at METC, (2) modification of an existing model (PCGC-2) to include active mineral matter such as alkali metals, (3) inclusion of water slurry droplets, (4) generalization of the combustor geometry, and (5) extension of PCGC-2 to permit additional feed streams at various locations in the combustor. A modification of the CREE equilibrium routine has been incorporated to permit treatment of some condensed species (i.e., solid carbon and liquid water). PCGC-2 has been extended to allow for water slurry droplet vaporization and dispersion. Initial slurry droplet size information is specified as an input parameter, since no available correlation was applicable to a variety of nozzles. The gas-phase water chemistry was incorporated into PCGC-2 by generalizing the mixing progress variables. This method provides for two mixing variables and three sources of mass input to the combustor (e.g., coal off-gas, air, and water). PCGC-2 has also been modified to permit up to three additional gaseous feed streams into the top or side of the reactor vessel. The code has further been generalized to consider any tow-dimensional geometry, including those geometries with non-uniform shapes. The code has been integrated and calculations have been made for various geometries and for combustion of coal-water mixtures. The new integrated code had been debugged and convergence has been demonstrated for a practical coal-water mixture combustor. 75 refs., 47 figs., 7 tabs.

29720 **(DOE/MC/21233—T1) Evaluation of alternate combustor concepts for gas turbine application program. Monthly report No. 1, October 1984.** (Westinghouse Electric Corp., Concordville, PA (USA). Combustion Turbine Systems Div.). 7 Nov 1984. Contract AC21-84MC21233. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85002699.

This document is the first monthly Technical Progress Report for this project. The objective of this program is to determine the potential for controlling the products of combustion from a slagging combustor burning coal-derived fuels for application to gas turbines. This objective will be accomplished by characterizing the combustor concept and evaluation of the combustor performance through a test program burning coal water mixture and dry pulverized coal fuels. In addition, the impact of the products of combustion from this type of combustor operating on these coal-derived fuels has on conventional gas turbine operation, performance, and maintenance intervals will be evaluated. This 17 month program consists of four technical tasks and one task on program management. The four technical tasks are as follows: Task 1 - facility/combustor preparation; Task 2 - test program; Task 3 - data analysis studies; and Task 4 - system integration. 3 figs.

29721 (DOE/MI/10024—T2) Commercialization of the Staged Cascade Fluid Bed Combustor: a Cooperative Energy Technology Development Program. Final report. (Howard Univ., Washington, DC (USA). Fossil Energy Lab.; Energy and Environmental Engineering, Inc., East Cambridge, MA (USA)). 8 May 1984. Contract FC01-83MI10024. 197p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE85010813.

A cooperative venture has been established between a minority university and a minority-owned business enterprise, with the support of the US Department of Energy, to develop and commercialize an advanced concept in fluid bed combustion. This technology, if successfully developed, will permit coal to be burned in US industrial facilities in an environmentaly acceptable manner, at a cost competitive with oil fired steam generators. The technology has a larger application in the generation of steam from coal in utility boilers. The Staged Cascade Fluid Bed Combustor (SCFBC) is an advanced concept in Fluid Bed Combustion developed by personnel at Energy and Environmental Engineering, Inc. and at Howard University. The technology provides the potential for burning coal for steam raising, at a cost competitive with oil fired steam generators, while substantially reducing both sulfur oxide and nitrogen oxide emissions normaly associated with coal fired boilers. Coal is burned in the presence of limestone in fluid bed boilers to capture sulfur oxides released during combustion. The SCFBC has the potential of reducing limestone requirements by half while maintaining the same degree of sulfur oxide control. Preliminary evaluations of the SCFBC show that this system has the potential of generating steam with a 19% savings in capital cost and a 16% savings in operating cost over present generation Atmospheric Fluid Bed Boilers. 20 figs., 25 tabs.

29722 (DOE/PC/30283—T5) Conversion of oil-designed utility boilers to pulverized coal or coal-water mixture firing. Final report. Kimel, E.A.; Kemeny, P.; Fontana, G.; Pinson, M. (Burns and Roe, Inc., Oradell, NJ (USA)). Jun 1984. Contract AC22-80PC30283. 470p. NTIS, PC A20/MF A01; 1; GPO Dep. File Number DE85008518.

The conversion of existing oil fired electric generating units to either dual pulverized coal (PC)-oil or dual coal water mixture (CWM)-oil firing is an option which can result in significant oil consumption reductions. The purpose of this study was to evaluate both the engineering and economic feasibility of the conversion of generating units with only oil firing capability to dual PC-oil or CWM-oil firing and to determine the market potential of such conversions. This report includes a brief introduction, after which the organization is as follows: (1) market potential; (2) retrofit criteria; (3) conceptual designs; (4) economic evaluations; and (5) effects of coal ash content. 29 refs.

29723 (DOE/PC/60809—T4) Alkali atom impact reactions on coal combustion substrates. Quarterly report Nos. 6 and 7, November 15, 1984-June 15, 1985 and March 15, 1985-June 15, 1985. Bennett, J.E. (Arkansas State Univ., State University (USA). Dept. of Chemistry). 1985. Contract FG22-83PC60809. 13p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85012800.

Most of the effort since the preceding report has involved attempts to characterize the permeation of graphite walls by K/Na atomic vapors in the range 700 to 1100°C. For this purpose tube furnace experiments, scanning electron microscopy (SEM), and simultaneous Knudsen effusion - quadrupole mass spectrometry have been employed. The most quantitative of these procedures is the latter, and the major part of this report concerned with results from that source. A few results which are considered significant are also described, however, from the tube furnace and SEM experiments. 4 figs., 2 tabs.

29724 (DOE/PC/70764—2-Pt.2) Effect of in-situ heat treatment on coal char reactivity. Part 2. Temperature measurement in flames. Progress report, January 1-March 31, 1985. Essenhigh, R.H.; Shaw, D.W. (Ohio State Univ., Columbus (USA). Dept. of Mechanical Engineering). 23 Apr 1985. Contract FG22-84PC70764. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85012330.

Four methods of measuring temperatures in pulverized coal flames are being investigated or developed: (1) the suction pyrometer, which is thought to measure a weighted average of the gas and particle temperatures; (2) two-color pyrometer, primarily to measure the particle temperatures; (3) sodium line-reversal, primarily to measure the gas temperature; and (4) OH peak method in the uv, as a new alternative to sodium line-reversal which may be superior for measuring gas temperatures in the presence of particles. This report describes progress, mainly on development of the first two techniques, and plans now being implemented for development of the last two. 4 refs., 12 figs., 2 tabs.

29725 (IS-EMRRI—19, pp 103-112) Utilization of carbonate rocks and other calcium bearing materials as desulfurization sorbents in fluidized bed combustion. Kaelin, R.A.; Lemish, J. Dec 1983. NTIS, PC A07/MF A01. File Number DE85011356.

In Iowa State Mining and Mineral Resources Research Institute. Final report, July 1, 1982-September 30, 1983.

In reviewing literature pertinent to the state of the art in FBC technology, this research undertakes a three step approach to identify systematically potential problems which may hinder the use of calcium-rich materials as sorbents. The first step is a precombustion strategy which identifies a broader range of those limestones, dolomites, and dolomitic limestones useful as sorbents according to criteria based on previous runs of a known, limited number of calcium-rich materials. These criteria are being developed from trends in combustion efficiency revealed in data from bench- and pilot-scale FBC runs. The second step involves gathering data on the geologic distribution, availability, and transportability of those calcium-rich materials which have the potential to behave as useful sorbents. This includes characterizing those limestones, dolomites, and dolomitic limestones for their intrinsic properties as these properties relate to the performance of these calcium-rich materials in FBC units. The third step addresses the critical problem of treating and handling spent sorbent by methods which can transform FBC waste into a usable product. These three steps are being reviewed in a continually updated, annotated literature survey whicyh is useful as a single source of retrievable information addressing precombustion strategies for identifying sorbents, data on sorbent characterization, and information on handling spent sorbents.

29726 (STEV-FBA—84-5) Pellets as fuel II. A study of methods and ways of development in the combustion of pellets. Schuster, R. (Statens Energiverk, Stockholm (Sweden)). Dec 1983. 61p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. File Number DE85750862.

This report describes the second project concerning pellets and is part of a larger work also including peat, straw and reed. It consists of two main parts. The first part gives a base by structuring the methods used for the different combustion-stages. In the second part the methods are exemplified and real units are as a basis for general discussions. Finally, the need for a continued governmental support is identified. This support is recommended to emphasize measurements on/and evaluation of units during and after the development phase in addition to the economical support.

29727 (TNO-MT—83M-013687-RAD-SGE) Corrosion/erosion of materials for AFBC applications; cost 501 Project NL-9. Rademarkers, P.L.F.; Bos, L.; Van Wortel, J.C. (Nijverheidsorganisatie TNO, Apeldoorn (Netherlands). Metaalinstituut). Dec 1983. 35p. Nijverheidsorganisatie TNO, Apeldoorn (Netherlands). Metaalinstituut.

The program comprises the examination of uncooled rings and cooled tubes, which are exposed in the 4 MW atmospheric fluidized bed boiler (AFBB) at Apeldoorn. A description is given of the test facility, the methods and materials and the test conditions. Uncooled rings of several high temperature materials are exposed for various times in the bed, the splash zone and in the free-board. The coal which is burned contains 0.86% sulfur, and limestone is added as sorbent. The first results of metallographic and microanalytical examinations, carried out after exposure of 300, 700 and 1000 hrs, are described. Metal losses of 0.02 to 0.2 mm are observed, the attack in the free-board being more pronounced than in the bed. All exposed materials showed internal sulfidation, and chromium and manganese sulfides are formed. Tests with uncooled rings have been continued, and an additional period of about 1500 hrs has been reached. Cooled test tubes of ferritic boiler steels have been made and placed in the bed and in the free-board, the test temperatures being between 400 deg C and 600 deg C. The cooled tubes have reached operation times of 1000 hrs. The tests have been continued. (In English)

29728 (VTT-TIED—283) **Small district heating plants using indigenous fuels.** Ranne, A.; Ketola, T.; Aeijaelae, M.; Panula, E.; Huotari, J.; Pyykkoenen, M. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Jan 1984. 256p. (In Finnish). Valtion Teknillinen Tutkimuskeskus, Espoo (Finland).

The number of small district heating plants using indigenous fuels has grown rapidly in Finland during the last years. Many of these small plants have had many problems beginning district heating supply, related to the plants and their heat production as well as to the other parts of the district heating system: fuel supply system, construction of networks, selection of consumers, organization and the scarcity of resources and knowledge. The study included a one-year follow-up of twelve heating plants with boiler capacities of 1 to 10 MW. The fuels used in the plants were wood chips, sod peat or saw residues. The types of boilers as well as other components and equipment corresponded to the most common types used in Finland. Concerning the fuel supply system, the delivery systems and the characteristics of fuel and ash were classified. The equipment of the plants using indigenous fuels was considered thoroughly by paying attention to failures and lacks as well as to the faultless components. Availability, numbers and outage times due to failures, repairs and maintenance were determined. (In Finnish)

29729 (VTT-TUTK—295) **Process simulation software KATTILA. General routines.** Hallikas, J. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Aug 1984. 57p. (In Finnish). Valtion Teknillinen Tutkimuskeskus, Espoo (Finland).

The Domestic Fuel Laboratory at the Technical Research Centre of Finland (VTT) has developed a flowsheeting package for chemical processes. The software is intended for computation of processes in steady state. The special application of 'KATTILA'-software is simulation of boiler plants, for which it is well suitable because of its modularity and flexibility. This part presents the structure of the software and some unclassified routines generally used in the software. The program is a usual modular process flowsheeting package. Tearing streams are computed iteratively using Wegstein convergence accelerator. (5 refs.) (In Finnish)

29730 (VTT-TUTK—296) **Process simulation software KATTILA. Computation of equipment modules.** Hallikas, J.; Vartiala, H.; Miettinen, M.; Asplund, D. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Aug 1984. 56p. (In Finnish). Valtion Teknillinen Tutkimuskeskus, Espoo (Finland).

The Domestic Fuel Laboratory at the Technical Research Centre of Finland (VTT) has developed a simulation software for chemical processes. The software is intended for computation of processes in steady state. The special application of KATTILA-software is simulation of boiler plants, for which it is well suitable because of its modularity and flexibility. This part presents the mathematical models for computation of equipment modules. In the package there is in addition to the usual modules, some special modules to compute furnaces, heat exchangers and flash dryers for boiler plants. (9 refs.) (In Finnish)

29731 (VTT-TUTK—297) **Process simulation software KATTILA. Computation of material and flow properties.** Hallikas, J.; Miettinen, M. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Aug 1984. 40p. (In Finnish). Valtion Teknillinen Tutkimuskeskus, Espoo (Finland).

The Domestic Fuel Laboratory at the Technical Research Centre of Finland (VTT) has developed a flowsheeting package for chemical processes. The software is intended for computation of processes in steady state. The special application of Kattila-software is simulation of boiler plants, for which it is well suitable because of its modularity and flexibility. This part presents the inputs needed by the software and the instructions of use. (13 refs.) (In Finnish)

29732 (VTT-TUTK—298) **Process simulation software KATTILA. User handbook.** Hallikas, J.; Vartiala, H. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Aug 1984. 98p. (In Finnish). Valtion Teknillinen Tutkimuskeskus, Espoo (Finland).

The Domestic Fuel Laboratory at the Technical Research Centre of Finland (VTT) has developed a flowsheeting package for chemical processes. The software is intended for computation of processes in steady state. The special application of 'Kattila'-software is simulation of boiler plants, for which it is well suitable because of its modularity and flexibility. This part presents the inputs needed by the software and the instructions for use. (15 refs.) (In Finnish)

29733 (VTT-TUTK—312) **Simple heat transfer model for shell type boilers.** Holopainen, T.; Asplund, D. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Oct 1984. 74p. (In Finnish). Valtion Teknillinen Tutkimuskeskus, Espoo (Finland).

Research has started on handling different kinds of fire-type boilers belonging to shell type boilers, studying the boundary conditions of heat dimensioning. Particular emphasis has been placed on the development of a heat technical dimensioning method based on heat-transfer theory, suiting the boilers in question, which will lend itself to programming on VTT's Cyper 173 mainframe. The results obtained from the model have been compared with available test results and design values. (27 refs.) (In Finnish)

0150 Marketing And Economics

REFER ALSO TO CITATION(S) 31138, 31172

29734 (DOE/EIA—0333(85)) **Annual outlook for US coal 1985: with projections to 1995.** Paull, M.K.; Pantos, E. (USDOE Energy Information Administration, Washington, DC. Office of Coal, Nuclear, Electric and Alternate Fuels). May 1985. 46p. NTIS, PC A03/MF A01; 1 - GPO; GPO Dep. File Number DE85011973.

Energy Information Administration (EIA) projections of coal supply and use are highlighted and discussed, with special attention given to the factors affecting the future growth of coal use. This report provides a more detailed analysis of the coal forecasts in the EIA's "Annual Energy Outlook 1983" (DOE/EIA-0383(83)). An historical overview is first presented; the emergence of coal (1800-1947), the decline of coal (1948-1973), and the re-emergence of coal (post 1973) are covered. The resource base, technical reliability, and major laws affecting supply and use of coal are also examined. Future trends are analyzed for demand and supply projections for the time period 1985-1995. A comparison with other forecasts is also provided. Factors affecting the outlook for coal are discussed, including leasing, transportation, exports, amendments to the Clean Air Act, synthetic fuels, financial requirements, and availability of certain coals. Concluding comments are also presented. A bibliography is provided. 4 figs., 6 tabs.

29735 (DOE/ET/10532—T23) **Refining and upgrading of synfuels from coal and oil shales by advanced catalytic processes. Tenth Interim Report. Revised stock balances and updated cost estimates.** Frumkin, H.A. (Chevron Research Co., Richmond, CA (USA)). May 1985. Contract AC22-76ET10532. 47p. (FE—2315-115). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85012359.

Design studies and cost estimates have been published under this contract from 1978 through 1984. While each estimate was based on the best available data and methods at its publication date, cost indices changed and methods were improved with the passage of time. This report revises all the previous results to a common, consistent basis. The overall product yields, overall investments, and per-barrel refining costs summarized in Table 31 are now suitable for use in internal comparisons and any future evaluations where stand-alone synfuel refineries are under consideration. Reforming yield predictions are now based on actual data with coal naphthas. Reforming hydrogen production is higher than had been originally estimated, allowing smaller hydrogen plants and, hence, lower costs especially in the all-gasoline cases. Because of the above change, making all-gasoline is no longer clearly more expensive on a volume basis than making kerojet and gasoline, as had been previously concluded. Costs for the two product slates are now closer together and the most economic product slate is feed-dependent. 8 refs., 31 tabs.

29736 **(DOE/PE—0073) Effects of railroad regulatory reform on coal and electricity. Draft.** (USDOE Assistant Secretary for Policy, Safety and Environment, Washington, DC. Office of Coal and Electricity Policy). May 1985. 210p. NTIS, PC A10/MF A01; GPO Dep. File Number DE85012362.

The results to date of a study started in mid-1984 to determine how rail transportation policies are affecting United States coal markets and electricity support the following conclusions: "Partial rail deregulation" is not now inhibiting the US from providing adequate supplies of utility coal. The basic principles of differential pricing, endorsed by the Staggers Rail Act of 1980, appear to be contributing to the improved operational and financial health of the nation's railroads. Although no modification to the Staggers Act is suggested here, some regulatory "fine tuning" is in order to balance the requirements of an efficient free enterprise system with the needs of those utility coal shippers who are vulnerable to monopoly abuse.

29737 **(NP—5750832) Government bill 1983/84:158 concerning certain coal topics.** (Energidepartementet, Stockholm (Sweden)). Mar 1984. 102p. (In Swedish). NTIS (US Sales Only), PC A06/MF A01. File Number DE85750832.

This government bill contains guidelines for the steam coal consumption in Sweden up to 1990. A moderate increase of the coal consumption to some 3-4 M tons/year is planned. This represents a reduction by 1/3 compared to level recommended by the parliament 1981. The erection of new plants is controlled by an application procedure, compulsary for coal fired district heating centrals, and local heating centrals above 0.5 MW. This restriction is not applied to industrial plants situated outside district heating or natural gas distribution areas. New standards for emmission of sulfur are also proposed; for large plants with yearly emissions above 400 tons, an upper limit in the interval 0.05-0.10 g sulfur/MJ coal consumed is suggested and for smaller plants an upper limit of 0.10-0.17.

29738 **(VTT-TIED—270) Fuel use of coal. Part 1. Preliminary study.** Mutanen, K.; Kallio, M.; Micttinen, M.; Okkonen, J.; Vesterinen, R. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Jan 1984. 159p. (In Finnish). Valtion Teknillinen Tutkimuskeskus, Espoo (Finland).

The report presents the coal resources of the world, coal consumption and trade, Finnish import and use of coal, and the properties of coal. The techniques of production, handling and use of coal are surveyed. The developing requirements for coal which are most important to Finland are reviewed. Chemical refining of coal is not included in this report. The object of this report is to give basic information of coal to people working in coal use or research and to authorities working with coal. (66 refs.) (In Finnish)

29739 **Enhanced coal technology. Hearing before the Subcommittee on Energy and Mineral Resources of the Committee on Energy and Natural Resources, United States Senate, Ninety-Eighth Congress, First Session, August 9, 1983.** Washington, DC; Government Printing Office (1985). 465p.

The future market for coal brought 25 witnesses to a field hearing in Blacksburg, Virginia. The witnesses represented the Export-Import Bank, DOE, electric utilities, the International Energy Agency, manufacturers, railroads, and other parties concerned with unemployment in the coal-mining regions and the economic opportunities that would result from expanded coal use and trade. There was an emphasis on the importance of coal to the economy and well being of the state, as well as on the importance of using the latest technology for mining, transporting, and using coal in order to protect the environment. A policy of government-industry cooperation could help to improve the stagnant growth of the coal market. An appendix with additional material submitted for the record follows the testimony.

0160 Health And Safety

REFER ALSO TO CITATION(S) 29711

29740 **(VTT-TIED—323) Safe production and use of domestic fuels. Part 1. Prestudy.** Mutanen, K.; Ahonen, A.; Rautalin, A.; Rouhiainen, V.; Weckman, H.; Vuorio, M. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). May 1984. 110p. (In Finnish). Valtion Teknillinen Tutkimuskeskus, Espoo (Finland).

This paper describes the current level of knowledge and research on the safe production and use of Finland's fuels and the safety codes applied. Data on workers' safety, fires and explosions have been collected. The investigation concentrates especially on the production and transport of peat, and the combustion and processing of all solid domestic fuels, but does not cover district heating or boilers. (49 refs.) (In Finnish)

0170 Legislation And Regulations

REFER ALSO TO CITATION(S) 29739

02 PETROLEUM

REFER ALSO TO CITATION(S) 29613

29741 **(CONF-8505141—1) Functional form analysis of the short-run demand for travel and gasoline by one-vehicle households.** Greene, D.L.; Hu, P.S. (Oak Ridge National Lab., TN (USA)). Apr 1985. Contract AC05-84OR21400. 23p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85011932.

From The Institute of Management Sciences/Operations Research Society of America meeting; Boston, MA, USA (1 May 1985).

The short-run elasticity of vehicle travel and gasoline demand is analyzed using gasoline purchase diary data for households in the US owning one vehicle. A Box-Cox method (iterative ordinary least squares) is used to determine best functional forms for each of four income quartiles in the sample. All income groups' transformation parameters are found to be close to 0.4. Thus, price elasticity increases with increasing fuel prices. Elasticity estimates at the mean for the three upper quartiles are -0.6, and that for the lowest quartile is approximately -0.5.

0201 Reserves

REFER ALSO TO CITATION(S) 29754

29742 **(RAND/N—2049-DOE) Linking US oil and gas reserve estimates.** Nehring, R. (RAND Corp., Santa Monica, CA (USA)). Sep 1984. Contract AC01-80PE70271. 196p. NTIS, PC A09/MF A01; GPO Dep. File Number DE85012399.

During the past decade, two reports on United States oil and gas reserves have been published: (1) the combined annual reports of the Committee on Reserves of the American Petroleum Institute (API) and the Committee on Natural Gas Reserves of the American Gas Association (AGA) for the years up to and including 1979, and (2) the annual reports of the Energy Information Administration (EIA) of the Department of Energy for the years beginning in 1977. These two series do not agree on either the total reserve estimates or the annual changes in reserves. The purpose of this note is to provide an informed, plausible series of proved reserves and annual reserve changes by type for crude oil and natural gas (dry) that links these two different series of reserve estimates over the late 1970s. Section I describes the basic differences between the two published series of reserve estimates, explores the possible reasons why differences between the two series occurred, and describes the approach we followed in creating a linked series. Section II presents the published and linked estimate of crude oil reserves, reserve changes by type, and production for the 43 individual states and statistical subdivisions for which crude oil reserve data have been published. Section III presents the published and linked estimates of natural gas reserves, reserve changes by type, and production for the 41 individual states and subdivisions for which natural gas reserve data have been published. Section IV provides aggregate estimates of crude oil and natural gas reserves for the United States as a whole. 8 figs., 100 tabs.

29743 **(USGS-OFR—83-559) Estimated oil and gas reserves, Southern California Outer Continental Shelf, December 31, 1982.** Ballantyne, R.S. (California State Univ., Hayward (USA)). 1983. 10p. US Geological Survey, Box 25425, Denver Federal Center, Denver, CO 80225. File Number TI85901596.

Remaining recoverable reserves of oil and gas in the Outer Continental Shelf off Southern California are estimated to be 968 million barrels of oil and 1,851 billion cubic feet of gas as of December 31, 1982. These reserves are attributed to 14 fields. Original recoverable reserves from these fields are estimated at 1,217 million barrels of oil and 1,983 billion cubic feet of gas. The estimates for both the remaining and the original recoverable reserves of oil and gas are higher than the corresponding estimates for December 31, 1981. Reserve estimates for 12 fields were based on volumetric reservoir studies. Decline-curve and volumetric analyses were used for the remaining two fields. Six fields were on production at year's end and a gas field is scheduled to commence production in 1983. 5 refs., 2 figs., 1 tab.

0202 Geology And Exploration

REFER ALSO TO CITATION(S) 29805, 31137

29744 **(ANL/ES—146) Geology and petroleum resources of basins in western China.** Ulmishek, G. (Argonne National Lab., IL (USA)). Nov 1984. Contract W-31-109-ENG-38. 137p. NTIS, PC A07/MF A01; GPO Dep. File Number DE85013038.

Western China contains 11 recognized petroliferous or potentially petroliferous basins. Despite their great difference in size, these basins have important common features: (1) their Mesozoic-Cenozoic sedimentary sequences are composed of rocks of essentially terrestrial origin, and (2) they experienced predominantly compressional stress during the late stages of their geologic history. The report is structured on a regional basis. The topics discussed for each basin include the stratigraphic and lithologic composition of the sedimentary cover, the major stages of tectonic development and the present-day structural framework, known oil and gas fields, probable source rocks, reservoir rocks, traps and seals, and potentially important exploration plays. The basins occupy 800,000 km^2 of land and contain over 4,000,000 km^3 of prospective sedimentary rocks. The most probable amounts of undiscovered petroleum resources in all these basins are estimated at 19.5 billion barrels of oil and 78 trillion cubic feet of gas. The Tarim, Zhungaer, and Chaidamu basins possess the great majority of these resources. 111 refs., 48 figs., 9 tabs.

29745 **(DOE/METC—85/0219) Arctic and offshore research. Technology status report.** (USDOE Morgantown Energy Technology Center, WV). Oct 1984. 32p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85001995.

The DOE Arctic and Offshore Research (AOR) effort is designed to meet the needs for a centralized, high-quality, Arctic energy-related data base and for long-term, high-risk research. The ultimate purpose of the DOE effort is to promote extensive private use of the evolving AOR technology data base in order to accelerate development of Arctic oil and gas resources. In assessing the Arctic energy-related research needs as delineated in this report, the Morgantown Energy Technology Center (METC), with the DOE Fossil Energy Office of Oil, Gas, and Shale Technology, developed the following activities: AOR Energy-Related Technology Data Base Development; AOR Seminars and Workshops; Arctic and Offshore Energy Research Coordination; Sea Ice Research; Seafloor/Soils Research; and Subice Systems Development. The DOE AOR effort was initiated in FY 1983, the early development activities were performed in January and February 1983, and the effort evolved to its present form by the conclusion of FY 1984. The current activities have included determining the Arctic bibliographic data base and initiating most pieces of the research described above (except multiyear ice properties and pipeline research). Some of the FY 1984 major accomplishments are: four to five ice islands 1 to 2 miles in length drifting off the Ellesmere ice shelves north of Ellesmere Island were aerially surveyed. A report was completed on the location of the ice shelf edge, breakup, and regrowth of the Ellesmere ice shelves over the past two decades. Ice-ridging shear zone studies have shown that the 6- to 10-feet high shoals usually under the shear zone are not totally destroyed from ice gouging from one year to the next, but that the ice gouging may be instrumental in initiating and maintaining the shoals, which may protect Arctic offshore structures. Airborne radar sensing techniques were used to determine the electromagnetic properties of sea ice and physical properties.

29746 **(NIPER—20, pp 23-32) Surface chemistry of reservoir rocks and their reaction with crude oil components.** 28 Feb 1985. NTIS, PC A16/MF A01. File Number DE85000122. Contract FC03-83FE60149.

In NIPER annual report, 1984.

A research study was conducted to delineate the nature of reservoir rock-fluid interactions. Work concentrated on determining the physical, surface, and chemical properties of a series of carbonate and sandstone reservoir cores. This basic work is an essential part of overall reservoir characterization, and is valuable input for the design of EOR processes. A number of analytical techniques were used to define the physical and chemical properties of the sandstone and carbonate reservoirs. Energy dispersive x-ray spectroscopy analyses supported by scanning electron microscopy observations indicated the presence of clays and clay minerals in three distinct morphologies in sandstone samples. Bulk chemical composition of the sandstones, as determined by inductively coupled plasma spectroscopy, differed considerably from the surface composition indicating more reactive elements were present on the sandstone surface. The surface analysis of carbonates was generally no different than the bulk analysis. Cation exchange measurements on the sandstones using a whole core method were more indicative of the potential of a reservoir to react with EOR chemical than the standard method using crushed core samples. X-ray diffraction was used to identify and quantify the clays in the sandstones; the carbonates generally contained only traces of clays as compared to as much as 11.8 wt. percent for the sandstones. Berea sandstone showed a large difference in wettability between the whole oil and a polar compound fraction of the oil. It also showed large differences in wettability depending on the composition of the polar fraction. Gas chromatography/mass spectroscopy (GC/MS) analysis of the polar compound fractions indicated considerable hetero-compound character.

29747 **(NIPER—20, pp 33-42) Effect of clay minerals on oil saturation determination.** 28 Feb 1985. NTIS, PC A16/MF A01. File Number DE85000122.

In NIPER annual report, 1984.

A research program was undertaken to determine the effects of formation variables such as clay content, brine concentration, and oil gravity on the determination of residual oil saturations in heavy oil reservoirs. Oil saturations were determined using standard laboratory techniques for evaluating fluid saturations in the heavy oil cores. Samples were acquired from three heavy oil reservoir formations: Bartlesville (KS), Rimrock (UT), and Big Clifty (KY). A unique situation was presented by the Big Clifty samples since natural state, fireflooded, and pre- and post-steamflooded samples were available. Special attention was given to the effects of these floods on the alteration of formation clays. The visual and chemical analyses of the clays found in the Big Clifty pre- and post-flood samples indicated that the floods did not alter the clays significantly in the core samples. Laboratory oil saturation measurements by three different methods indicated good agreement on the better preserved samples. Water saturations as determined by visual observation during centrifuge displacement tests were less than those values determined by resistivity measurements. These higher values by the resistivity methods were attributed to the secondary properties of the rock/fluid system and specifically in this case the clay content. The resistivity values were found to increase in proportion to an increase in clay content. The increase was more pronounced in the heavy oils as compared to the light oils.

29748 (NIPER—20, pp 43-51) **Three-phase flow in porous media.** 28 Feb 1985. NTIS, PC A16/MF A01. File Number DE85000122.

In NIPER annual report, 1984.

A thorough literature search was performed to define the state of the art of different laboratory techniques available for measuring three-phase relative permeability. The search showed that the study of three-phase flow phenomena has been largely neglected because of the many complexities involved in the laboratory tests. One of the biggest difficulties encountered is to monitor laboratory fluid saturation profiles. Several methods for laboratory saturation measurement; such as x-ray absorption, γ ray absorption, and microwave absorption have been used successfully to determine fluid saturation distribution in core samples during laboratory floods. The x-ray and microwave absorption techniques will be used in this research to determine reproducible and accurate oil and water saturations, respectively. Two-phase relative permeabilities of two different fluid systems were measured. A conventional experimental setup has been used to measure this property. The equipment is identified as conventional since only volumetric and gravimetric techniques could be used to determine fluid saturation. The two-phase relative permeability data are necessary in the theoretical determination of three-phase relative permeability using a modified Stone's equation. The validity of this equation will be checked using three-phase relative permeability data obtained with the computer-controlled x-ray/microwave system.

29749 **AAPG Eastern Section and US Department of Energy joint meeting.** *American Association of Petroleum Geologists, Bulletin;* **63**: No. 9, 1575-1592(May 1982). (CONF-791003—).

From 3. Eastern gas shales symposium; Morgantown, WV, USA (1 Oct 1979).

A list of authors and titles of papers from this meeting for which abstracts are published appears at the back of this issue of Petroleum Abstracts as Appendix A.

0203 Drilling And Production

REFER ALSO TO CITATION(S) 29743, 29746, 29747, 29748, 29785, 29810

29750 **(DGRST—81-D-0092) Solubilizing power of surfactants and interfacial properties of middle phases linked to enhanced oil recovery.** Lachaise, J.; Graciaa, A. (Delegation Generale a la Recherche Scientifique et Technique (DGRST), 75 - Paris (France)). Dec 1982. 261p. (In French and English). NTIS (US Sales Only), PC A10. File Number DE85751353.

Brine/oil/surfactant/alcohol systems comprise 2 or 3 phases, the surfactant-rich phase is called microemulsion for a two-phase system or middle phase for a three-phase system. Middle phases are of great interest for enhanced oil recovery because they can solubilize simultaneously large amounts of oil and brine and interfacial tension with other phases are low enough to improve recovery of residual oil trapped in deposits. Contribution to low surface tension of middle phase measurement by light scattering, formation of two-phase or three-phase system, influence of surfactants on middle phase, partition of non-ionic surfactants between water, oil and micellar phase and influence of partition on efficiency of commercial surfactants are examined.

29751 **(DOE/ET/13077—105) Commercial scale demonstration: enhanced oil recovery by micellar-polymer flood. Seventh annual report, October 1983-September 1984.** Mueller, L.M. (Marathon Oil Co., Findlay, OH (USA)). May 1985. Contract AC03-78ET13077. 83p. NTIS, PC A05/MF A01; GPO Dep. File Number DE85000128.

Information in this report is presented under three Work Breakdown Structure (WBS) elements: WBS 2100 - fluid injection; WBS 2300 - performance monitoring; and WBS 2400 - economic monitoring. WBS No. 2100 - Fluid Injection: (1) Polymer injection was completed in the 2.5-acre pattern while injection continues at a concentration of 625 ppM in the 5.0-acre pattern. Polymer concentration at the 2.5-acre pattern was reduced from 100 ppM to 50 ppM and then, upon completion of polymer injection, from 50 ppM to fresh water. (2) Copper coils are used to reduce injection rates at the M-1 because the coils can reduce wellhead pressure and still minimize the shear degradation of the polymer. WBS No. 2300 - Performance Monitoring: (1) Presently, the 2.5- and 5.0-acre patterns are producing at oil cuts of 2.7% and 8.6%, respectively. (2) The annual transient test results for the six injectors and their six offset producers are reported. The results are compared to previous years' results and indicate little change in mobility and skin factor over the past year. (3) Subsequent to injection of tritiated water into ten injection wells, all producing wells have been analyzed regularly for the presence of tritiated water. A discussion of the directional flow trends determined from tritiated water analysis is reported. (4) Samples of produced fluid are analyzed regularly for water soluble sulfonate content (a micellar slug component). An analysis of samples taken in June, 1984, shows 81 2.5-acre wells (89%) and 39 5.0-acre wells (95%) with sulfonate levels above background levels. (5) The M-1 biocide was switched from Tretolite XC-215 to Tretolite SC-510 in November, 1983. WBS No. 2400 - Economic Monitoring: (1) An economic analysis of the M-1 Project indicates that the production, investment, and expense which occur after 1983 do not significantly affect project economics. 19 figs., 6 tabs.

29752 **(DOE/METC—85/0221) Gas-miscible displacement: enhanced oil recovery. Technical status report, October 1, 1983-September 30, 1984.** (USDOE Morgantown Energy Technology Center, WV). Jan 1985. 23p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85001997.

The general goal of the Gas-Miscible Displacement Project is to support high-risk, long-term carbon dioxide/enhanced oil recovery (CO_2/EOR) research which does not duplicate or displace private or other public research and development (R and D) efforts in CO_2/EOR. More specifically, the project goals are to: understand displacement mechanisms of the CO_2/EOR process; provide predictive capability to forecast recovery from the CO_2/EOR process; and improve the CO_2/EOR process recovery efficiency. In order to accomplish these goals, the following research priorities have been identified: better mobility control of injected fluids; improved reservoir evaluation techniques through investigation of geologic and reservoir heterogeneity, residual oil saturation, and fracturing; improved understanding of oil swelling, viscosity reduction, and extraction/vaporization phenomena; improved predictive modeling; and field performance appraisal for tertiary oil recovery. Objectives of the research for fiscal year (FY) 84 and FY 85 are to complete the following: develop mobility control technology for improving the reservoir sweep efficiency of the gas flooding processes, develop gas flooding simulation research to provide acceptable levels of process predictability for adequate evaluation of economical and technical risks; develop phase behavior and displacement research activities to provide fundamental data on the processes that characterize and control macroscopic and microscopic oil recovery in gas flooding; develop novel concepts that will result in more efficient use of CO_2 and improved oil recovery; and demonstrate gas flooding technology through field testing of concepts demonstrated in laboratory and modeling studies. 2 tabs.

29753 **(DOE/SF/01424—T7) Multi-pattern low-tension demonstration flood, Big Muddy field. Technical progress report, January-March 1985.** Painter, T.R. (Conoco, Inc., Casper, WY (USA)). 1985. Contract AC03-78SF01424. 19p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85011201.

The injection of the polymer-pusher slug continued through the first quarter of 1985. A power failure on February 9, 1985, caused a half-day plant shutdown, and the start-up of the plant on the next day resulted in a minor pump problem in the polymer-mixing stage. Approximately 1100 barrels of high-viscosity polymer slop had to be disposed of, but normal plant operations were quickly restored. A total of 1,393,200 barrels of polymer-pusher slug has been injected through March 31, 1985, which is approximately 80% of the planned slug size. Project injection was 629 BPD in March, down from 1136 BPD in December due to another intentional rate cut-back. This cut-back was also made to eliminate pressure-parting, and individual well injection rates were revised according to step-rate parting tests run in November. Oil production fell from 119 BOPD in December to 85 BOPD in March. Most of the decrease was due to an intentional production cut-back to match the injection cut-back, thus maintaining pattern balance. February production was low due to an estimated 780 barrels of bad oil in storage, which will be treated and sold in April. January production was high by 420 barrels of oil due to a LACT pump failure in late December. The March production of 85 BOPD was a reasonable measure of the actual oil rate for the project. Cumulative project production was 217,178 barrels of oil as of March 31, 1985 (sales only). Sulfonate was produced in all wells with Well 88 showing the highest level in the oil (1875 ppM). The production-weighted average remained at 350 ppM. The auxiliary treating facility, with the exception of one upset due to an attempt to remove a high iron-sulfide pad from the treater and FWKO's, continued to achieve merchantable oil. 6 figs., 4 tabs.

29754 (NIPER—20, pp 53-57) **EOR national potential.** 28 Feb 1985. NTIS, PC A16/MF A01. File Number DE85000122.

In NIPER annual report, 1984.

As a first step in determining the impact of including reservoirs with less than 50 million barrels of original oil in place (OOIP) on predicting the National EOR potential, data were collected on over 600 oil reservoirs containing between 20 and 50 million barrels of OOIP. Data were also collected for about 400 reservoirs containing over 50 million barrels of OOIP. Some of these may be duplicate reservoirs, however these sources may contain pieces of information missing in the data base. A separate task of this subproject was to determine the potential of applying EOR technology to abandoned wells. Our data showed that over 90% of the abandoned oil fields in the US are not a viable enough EOR target to justify the effort required to add them to the Department of Energy's reservoir data base.

29755 (NIPER—20, pp 59-64) **Technology appraisal.** 28 Feb 1985. NTIS, PC A16/MF A01. File Number DE85000122.

In NIPER annual report, 1984.

Information on 225 EOR projects has been collected for DOE's EOR project data base. These data indicate that polymer flooding (76 projects) is the most popular EOR process started in the 1980's followed by steamflooding (29 projects), carbon dioxide immiscible (15 projects), and carbon dioxide miscible (12 projects). Other EOR processes averaged less than one project per year over this period.

29756 (NIPER—20, pp 65-76) **Process predictive screening models.** 28 Feb 1985. NTIS, PC A16/MF A01. File Number DE85000122.

In NIPER annual report, 1984.

DOE's process predictive models were studied and their sensitivities to input parameters was determined. The chemical flood model was improved by correcting errors and adding provisions for line drive and seven-spot injection patterns. This model is very sensitive to pattern size, surfactant slug size, and permeability. For the steamflood predictive model several errors were corrected and the four algorithms evaluated. The Gomaa algorithm gave the best match to field data, while the Intercomp algorithm was the most flexible and had more realistic sensitivity to input data. Two of the DOE's cost-shared projects were selected for more detailed study using finite difference simulators. The projects were the North Burbank Chemical Flood and the Bodcau In Situ Combustion.

29757 (NIPER—20, pp 87-93) **Behavior of surfaces with adsorbed materials.** 28 Feb 1985. NTIS, PC A16/MF A01. File Number DE85000122.

In NIPER annual report, 1984.

Electrophoretic mobilities were measured on natural and homoionic (sodium) kaolinite before and after adsorption of sodium octylbenzene sulfonate, sodium dodecylbenzene sulfonate, and a sodium alkyldiphenyl ether disulfonate, over a range of pH values from 4 to 11. A correlation was found between adsorption and zeta potential for each adsorbate. The potential utility of the results is examined.

29758 (NIPER—20, pp 95-104) **Adsorption of surfactant slug chemicals.** 28 Feb 1985. NTIS, PC A16/MF A01. File Number DE85000122.

In NIPER annual report, 1984.

In the first part of this report, the interaction of alcohol cosurfactant with solid surfaces was studied. A relationship between the interactions with water-wet and with oil-wet surfaces and chain length of alcohol is reported. In the second part, the interactions of surfactants with different surfaces were taken up. The general conclusions are that water-wet surfaces interact more strongly with surfactants dissolved in hydrocarbons than those dissolved in water. Oil-wet surfaces have a higher interaction with surfactants in water, even with ionic surfactants. The third section describes preliminary work with polymers, and suggests that flow adsorption calorimetry with the LKB system is a contradicted technique for this study.

29759 (NIPER—20, pp 105-110) **Application of thermodynamic measurements to micellization and solubilization.** 28 Feb 1985. NTIS, PC A16/MF A01. File Number DE85000122.

In NIPER annual report, 1984.

Thermodynamic property measurements have been made for sodium octylbenzene sulfonate (SOBS) in water and for n-pentanol in mixtures of SOBS + water over a range of concentrations at 303.15 K. Enthalpies of dilution, heat capacities, and densities were measured. Relative apparent molal enthalpies, apparent molal heat capacities, and apparent molal volumes were calculated as a function of concentration from the experimental data. The results were fit with a model for the thermodynamics of ionic surfactant solutions developed during the previous year. The model was extended to include expansibilities and compressibilities for surfactants in aqueous solutions. Modifications were made to the model to consider effects of added electrolyte on the properties of surfactants in water. The results provide new and useful insights into the behavior of alkylbenzene sulfonates in solution.

29760 (NIPER—20, pp 111-120) **Effects of surfactant structure on micelle formation and solubilization.** 28 Feb 1985. NTIS, PC A16/MF A01. File Number DE85000122.

In NIPER annual report, 1984.

Thermodynamic property measurements have been made for 2-butanol in aqueous solutions of sodium octylbenzene sulfonate (SOBS) at 303.15 K. Heat capacity and density measurements were made as a function of the concentrations of both 2-butanol and SOBS. Solubilities of n-butanol, i-butanol, 2-butanol, n-pentanol, and i-pentanol were measured in aqueous solutions having varying concentrations of SOBS. The solubility of 2-butanol in aqueous solutions of two isomers of dodecylbenzene sulfonate and in sodium dodecyl sulfate were also determined. Comparison of the results with those obtained under project BE4C for n-pentanol in aqueous solutions of SOBS provides some useful insights into the role of surfactant and cosurfactant structure in solubilization. Small angle x-ray scattering was used to obtain distance distribution functions in emulsions formed with two nonionic surfactants and three oils (hexadecane and two asphaltic crudes).

29761 (NIPER—20, pp 121-126) **Order of mixing effects for aqueous surfactants.** 28 Feb 1985. NTIS, PC A16/MF A01. File Number DE85000122.

In NIPER annual report, 1984.

Measurements of capacitance and conductance for different orders of mixing have been completed for two petroleum sulfonates, Amoco Floodaid 141 and Witco TRS 10-410. The results are consistent with microscopic observations, and increase our understanding of the structure of these solutions.

29762 (NIPER—20, pp 121-138) **Gas displacement methods.** 28 Feb 1985. NTIS, PC A16/MF A01. File Number DE85000122.

In NIPER annual report, 1984.

The project has two parts, one related to the enhanced recovery of heavy oil by CO_2 injection and the second related to light oil recovery by nitrogen injection under miscible conditions. In the first part of the project, measurements were made on two heavy crude oils, namely, Bartlett (Kansas) and Merey (Australia). The measurements included effects due to CO_2 dissolution on viscosity reduction, density change and crude oil swelling. From measurements of CO_2 dissolution in heavy crude oil it was found that the viscosity is monotonically decreased with an increase in CO_2 saturation (representing higher pressures). A method for predicting viscosity of heavy oil and CO_2 mixtures is being developed. Also, the variation of heavy crude oil viscosity with changes in pressure and temperature was determined. In the second part of the project, equipment and apparatus were constructed to provide means for measuring the phase behavior of nitrogen and light oil mixtures, and the minimum pressure by nitrogen injection required to achieve miscible displacement of light oil from a slim-tube packed with fine-grained solid material to simulate a porous medium. The apparatus was designed to be operable when used for simulating normal oil reservoir pressures and temperatures. A series of laboratory slim-tube flooding tests were conducted displacing a 37.9° API Oklahoma City Field (Prue) crude with nitrogen with pressures up to 6000 psi at a reservoir-simulated temperature of 160° F. The minimum miscibility pressure (MMP) was not reached.

29763 (NIPER—20, pp 159-172) **Reservoir characterization for EOR application.** 28 Feb 1985. NTIS, PC A16/MF A01. File Number DE85000122.

In NIPER annual report, 1984.

To monitor the progress of a fluid front during an EOR operation the feasibility of applying one or more surface or borehole geophysical tools was investigated. Due to the rapid advances made in recent years in the acquisition, processing, and display of seismic data, it may be concluded that EOR processes where there is injection or generation of gas will be relatively easy to monitor by high resolution seismic techniques because of sharp changes in acoustic impedance brought about in these processes. However, the acoustic impedance changes in the chemical EOR process are expected to be much smaller and rigorous experimentation is required to find if a stable slug of air or nitrogen foam could be injected at some point in the chemical flood to artificially lower the acoustic impedance so that a chemical flood front can be monitored seismically. The sharp changes in resistivity along the chemical flood can provide enough contrast for such processes to be monitored by one of the suitably modified electromagnetic devices. All surface measuring electrical and electromagnetic devices have a depth limitation due to various types of noise and the only way to circumvent this problem will be to lower the excitation electrodes inside the boreholes and measure the perturbing fields on the ground surface or in another borehole.

29764 (NIPER—20, pp 173-184) **Improved chemical flooding agents: surfactant systems.** 28 Feb 1985. NTIS, PC A16/MF A01. File Number DE85000122.

In NIPER annual report, 1984.

Surfactants of high disulfonate content were found to behave in a manner not fully ascribable to low equivalent weight. They exhibited some cosurfactant character. Calcium appeared to be associated with the disulfonate in transport between phases. One biosurfactant examined was effective in mobilizing oil at low salinity and low pH without a cosurfactant.

29765 (NIPER—20, pp 185-194) **Mobility control agents.** 28 Feb 1985. NTIS, PC A16/MF A01. File Number DE85000122.

In NIPER annual report, 1984.

Screen factors of P-500 differed from shear viscosity in the following ways: 1) flow resistance increased with flow rate; 2) concentration dependence decreased at higher concentration; and 3) increasing salinity caused a greater departure from Newtonian behavior. Surfactant/crude oil and caustic/crude oil systems were found that gave stable macroemulsions at 110°C. Oil-in-water emulsions were formed at the low salinities expected in steamfloods. They caused stable blocking of flow when injected into Berea cores.

29766 (NIPER—20, pp 195-204) **Alkaline flooding.** 28 Feb 1985. NTIS, PC A16/MF A01. File Number DE85000122.

In NIPER annual report, 1984.

In a three phase project, work was initiated on alkali-mineral interaction, alkali-oil interaction, and alkali-polymer interaction. Representative minerals were prepared in standard reference condition and characterized for cation exchange capacity. In tests of the effect of carbonate and bicarbonate on emulsification-demulsification of several heavy crudes, it was found that bicarbonate promoted favorable behavior. Alkaline conditions slightly decreased the intrinsic viscosity of a polyacrylamide, but its viscosity was increased at concentrations typical of a mobility buffer slug.

29767 (NIPER—20, pp 205-220) **Steamflooding.** 28 Feb 1985. NTIS, PC A16/MF A01. File Number DE85000122.

In NIPER annual report, 1984.

The use of the steamflooding EOR process to recover light crude oils was investigated. The results of coreflooding experiments suggest that light crude oils can be successfully recovered using steamflooding. Ultimate oil recovery was independent of initial fluid saturations, injected steam quality, steam injection rate, pressure drop across the core, and core permeability. Ultimate recovery decreased as the concentration of polar compounds in the crude oil increased. These preliminary experimental results indicate that distillation is the primary displacement mechanism when steamflooding is used to recover light crudes.

29768 (NIPER—20, pp 221-230) **In situ combustion.** 28 Feb 1985. NTIS, PC A16/MF A01. File Number DE85000122.

In NIPER annual report, 1984.

The effect of vanadium, nickel, and iron on processes which occur during in situ combustion has been investigated. Combustion and cracking reactions were examined using thermoanalytical techniques. The metals were added in soluble form to natural heavy crude oil. The presence of these metals has a catalytic effect by increasing the amount of coke deposited, decreasing the temperature of combustion, and increasing the amount of heat given off by the combustion. The quantity of coke deposited is significant because it would influence the amount of air required by the process and therefore the economics of the process. Lowered combustion temperature and increased heat of combustion could affect the ignition of the reservoir hydrocarbons and the ability for the combustion to sustain itself.

29769 (SGP-TR—82) **Velocity and gravity effects in relative permeability measurements.** Beal, B.A.; Nunes, C.S. (Stanford Univ., CA (USA). Stanford Geothermal Program). Jun 1984. Contract AT03-80SF11459. 154p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE85009925.

There have been several studies on the effects of gravity and flowrate on laboratory relative permeability measurements. Most of these studies have concentrated on the effect of these parameters on the flooding front. Miller's (1983) data showed that the influence of these and other variables are not understood. The study found that the calculated recovery at breakthrough was different than the observed recovery at breakthrough. The calculated recovery at breakthrough was based on theory derived from Buckley-Leverett piston-like displacement. This study attempted to determine how gravity or core positioning and flowrate of the displacing fluid might be used to achieve a stable flooding front. A relative permeameter with unsteady-state flow was used for the apparatus. The core material was an unconsolidated silica sand. The core was 2 in. in diameter and 20 in. long. The fluids were refined white mineral oil and salt water. All measurements were done at room temperature. This study found that gravity had no significant effect on the difference between calculated and observed recovery at breakthrough. It also observed that an increase in flowrate would increase the flooding front instabilities. Therefore as flowrate decreased the calculated and observed breakthrough approach a single value. 23 refs., 56 figs., 25 tabs.

29770 **Enhanced oil recovery. Lovington steam test goes down as a silent roaring success.** Calhoun, J. *Drill Bit;* **30**: No. 4, 89-90(Apr 1981).

A recent down-hole steam generation test conducted near Lovington, New Mexico by Sandia National Laboratories was a success. The experiment was a mock-up using a simulated generator with exact weight and dimensions of the real thing. The mock generator is 40 ft long and weighs 1500 lb. The next test, using the real thing, will involve a generator only 3 ft long. The test was the second in a series of 3. The first near Bakersfield, CA, utilized the steam-gas mixture to be generated by the devices, but pumped down hole from above ground. This test proved the feasibility of lowering the largest-envisioned steam generator into the well, along with peripheral equipment.

29771 **DOE report examines enhanced oil recovery constraints.** *Oil and Gas Journal;* **78**: No. 17, 105-117(28 Apr 1980).

A critical examination of the potential - and the technical constraints that inhibit application - of enhanced oil recovery (EOR) techniques in the US has been initiated. The examination is based on the results of extensive lab and field applications now underway under various types of US Department of Energy (DOE) support. Interim Rep. No. 1 Technical constraints limiting application of enhanced oil recovery techniques to petroleum production in the US., will be amplified as data become available and progress is made. The target for EOR methods is more than 300 million bbl, but all of this oil cannot be recovered even with the techniques being developed today. While recovery potential is uncertain, various studies estimate that from 20 to 50 billion bbl of that remaining may be produced using advanced recovery techniques. The DOE report states that the largest potential recovery will be realized from the 2 techniques furthest from large-scale, commercial application - miscible and chemical recovery. Highlights of the study's discussion of the technical constraints to the application of chemical recovery, miscible gas recovery, and thermal recovery processes are presented.

0204 Processing

29772 (NIPER—20, pp 251-274) **Stability and processing research for crudes, intermediate and process streams and finished fuel.** 28 Feb 1985. NTIS, PC A16/MF A01. File Number DE85000122.

In NIPER annual report, 1984.

The intent of this project is to demonstrate that one can predict refinery products quantities and qualities based on knowing in detail the composition of the feedstock and the upgrading conditions, even for very heavy, low quality crudes. While the correlations may be very different from those for light, sweet petroleum, it is postulated that satisfactory relationships can be derived given sufficient data. The savings in process design and efficiency for future plants could be tremendous. Much of this year has been spent in generating the samples on which detailed compositional and physical property analyses are to be performed. A Wilmington, CA, crude having an API gravity of 14 was distilled, and the heavy distillate was hydrotreated at a number of conditions. Preliminary analyses have been completed on the resulting upgraded samples. In addition, facilities for supercritical extraction and hydrotreatment of residues have been modified for automated operation to aid in data retrieval. A storage stability test that is applicable to small samples has been completed and is in the process of being modified for use with heavy fractions.

29773 **(STEV-BF—83-14) Building and running of a pilot catalytic cracker.** Matsson, M.; Roej, A. (Statens Energiverk, Stockholm (Sweden)). Jun 1983. 67p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. File Number DE85750843.

A pilot catalytic cracker for heavy oils has been built at Chalmer Univ. of Technology, on a licence from Atlantic Richfield, USA. The cracker is equipped with two gaschromatographs, one for refinary gas analysis, and one for simulated distillation. A reactor for microactivity tests has been built, to be used for fast characterization of catalysts and oils. Total investment cost is 2 MSEK. A procedure for the pilot cracker runs, including analyses and material balance calculations has been designed. The results show good reproducability and give high and stable material balances.

0205 Products And By-products

29774 **(AD-A—152087/3/XAB) Absorbance changes as a measure of fuel degradation. Technical note.** Coleman, J.R.; Gallop, L.D. (Defence Research Establishment, Ottawa, Ontario (Canada)). Dec 1983. 42p. (In French). (DREO-TN—83-33). NTIS, PC A03/MF A01.

The purpose of this work is to examine absorbance (optical density) changes as a method of following the degradation of aviation turbine fuels when subjected to thermal stress. Thermal degradation differs in some ways from degradation on storage, a problem arising from slow reactions between unstable fuel components with air, water, and container linings, as affected by diurnal or seasonal climatic changes. In commercial fuels a variety of additives - antioxidants, metal deactivators and corrosion inhibitors are introduced, primarily to reduce the effects of these long term processes. The concern here is with thermal stability - the resistance of the fuel to relatively brief periods of elevated temperature in the presence of air and of heated metal surfaces. A method for following the course of thermal degradation of aviation turbine fuels was examined, based on the Phillips 5-ml bomb test, and measuring absorbance changes in the thermally stressed fuel at 340 millimicrons. Comparisons were made with a method based on direct measurement of weights of solid deposited from the fuel.

29775 **(PB—85-183705/XAB) Thermodynamic characterization of conversion-process oils as materials of continuous distribution. Annual report, January-December 1984.** Weil, S.A.; Abbasian-Amin, M.J.; Landahl, C.D. (Institute of Gas Technology, Chicago, IL (USA)). Mar 1985. 82p. NTIS, PC A05/MF A01.

See also PB84-189091.

The proposed description of a continuous oil considers it as made up of a set of fractional continuous oils. The distribution functions of these fractional oils is appropriately based on the vapor pressure-boiling point-temperature dependence so that the form of the functions are maintained in equilibrium vapor-liquid transformations with explicit transformation rules for the parameters. An application of these concepts to sequential operations has shown that accuracy is maintained very well. From measurements of the equilibrium ratios of a shale oil in a low-pressure batch distillation system, a readily definable function of the boiling point proved to be a suitable characteristic variable for the proposed description. Also the apparent ideality of the system, with respect to liquid phase composition, is appropriate to the proposed description. A possible procedure for handling non-ideal liquid phase characteristics is being developed. A high-pressure batch distillation system was designed and is being constructed to extend the data base.

0206 Health And Safety

29776 **(NUREG/CR—4190) California offshore survey of licensees using radioactive material.** Wong, K.S.; Brown, J. (California Dept. of Industrial Relations, Sacramento (USA). Div. of Occupational Safety and Health; California Dept. of Health Services, Sacramento (USA)). May 1985. 19p. NTIS, PC A02/MF A01 - GPO. File Number TI85901487.

This report is an account of offshore radioactive material activities and was prepared to provide information about their safe use in the marine environments beyond California's jurisdiction. The report supplies the essential information called for and (a) identifies licensees with radioactive nuclide utilization programs, (b) describes the licensees' work stations, (c) identifies and/or describes radionuclide, quantities and their applications, and (d) describes the radiation safety concerns and existing methods for their resolution. Finally, three offshore sites were inspected in a typical compliance manner and the findings reported. Enclosed photographs of the work stations, during source and equipment use, illustrate conditions and the licensees' operations. It is concluded from observations during onsite visits to these unusual work environments, that periodic onsite compliance inspections are necessary to assure radiation protection for all concerned.

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0207 Marketing And Economics

REFER ALSO TO CITATION(S) 29751, 29787, 31138, 31153, 31154, 31172

29777 (DOE/EIA—0109(85/03)) **Petroleum Supply Monthly, March 1985.** (USDOE Energy Information Administration, Washington, DC). May 1985. 105p. NTIS, PC A06/MF A01; 1 - GPO; GPO Dep. File Number DE85012414.

This report contains detailed statistics on the supply and disposition of petroleum and petroleum products for March 1985. Information on crude oil, finished motor gasoline, distillate fuel oil, residual fuel oil, liquefied petroleum gases are included. Detailed statistics show production for the current month as well as the year-to-date. Data are also tabulated for the US Petroleum Administration for Defense (PAD) Districts which include field production, refinery production, imports, stock withdrawal or addition, unaccounted for crude, net receipts, crude losses, refinery inputs, exports, products supplied, and ending stocks. 13 figs., 33 tabs.

29778 **(DOE/EIA—0340(84)1) Petroleum Supply Annual, 1984. Volume 1.** (USDOE Energy Information Administration, Washington, DC). Jun 1985. 135p. NTIS, PC A07/MF A01; 1 - GPO; GPO Dep. File Number DE85013235.

Information on US supply, disposition and stocks of crude oil and petroleum products is provided for each month of 1984 in this first of 2 volumes. This volume contains two sections, petroleum supply summary and refinery capacity each with final and annual data. The summary includes a description of the major events in the petroleum industry during 1984 including trends in supply, consumption, and production. Graphs and tables are provided which show 12 years of data depicting the balance between supply, disposition and ending stocks for various commodities including crude oil, motor gasoline, distillate fuel oil, residual fuel oil and liquefied petroleum gases. Tables also provide 1984 detailed statistics on supply and disposition, refinery operations, imports and exports, stocks, and transportation of crude oil and petroleum products. The section on refinery capacity describes major activities within the refinery industry in 1984. Of particular note are listings of facilities and associated capacities in each State. In addition, summaries of corporate refinery capacities, refinery storage facilities in selected States, refinery shutdowns during 1984, refinery sales and mergers since 1981, and projected changes in input and production during 1985 and 1986 are provided. 12 figs., 44 tabs. (DMC)

29779 . (DOE/EIA—0340(84)/2) **Petroleum Supply Annual, 1984. Volume 2.** (USDOE Energy Information Administration, Washington, DC). 19 Jun 1985. 431p. NTIS, PC A19/MF A01; 1 - GPO; GPO Dep. File Number DE85013652.

Information on US supply, disposition, and stocks of crude oil and petroleum products is provided for each month of 1984 in this second of two volumes. This volume contains: national statistics; supply and disposition by Petroleum Administration for Defense (PAD) District; production of crude oil and lease condensate by State and PAD District; natural gas plant processing by PAD District; refinery operations by PAD District; imports and exports; stocks by PAD District; transportation; and heavy fuel oils by sulfur content. Explanatory notes describe the data collection forms and methodology. A glossary is provided. 29 tabs.

29780 (DOE/EIA—0380(85/03)) **Petroleum Marketing Monthly, March 1985.** (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). May 1985. 156p. NTIS, PC A08/MF A01 - GPO; GPO Dep. File Number DE85012994.

This report presents monthly summaries of petroleum product marketing statistics for the US, Petroleum Administration for Defense (PAD) Districts, and individual states. Four types of petroleum product statistics are included: sale prices, sale volumes, percentages of product sales, and first sales of products for consumption. Salient statistics are highlighted in a summary section, and each of the four subjects are treated in detail in other sections. The first tables in each of the first three sections provide national-level statistics on sales of the various products to end-users and for resale. The following tables provide finer geographic and type of seller detail and are grouped by product, beginning with motor gasoline and ending with either residual fuel, oil or propane. The majority of the tables show data for the report month and previous month for the current year. Data on motor gasoline, aviation fuel, jet engine fuel, kerosene, distillate fuel oils, residual fuel oils, and propane are included. A glossary is included. 17 figs., 75 tabs.

29781 (DOE/EIA—0469) **Energy Facts, 1984.** Daniels, J.E. (USDOE Energy Information Administration, Washington, DC). May 1985. 54p. NTIS, PC A04/MF A01 - GPO; GPO Dep. File Number DE85011950.

This booklet provides a quick reference to a broad range of domestic and international energy data for the general public, as well as for the technical community. It is especially designed for students and business people who need a quick reference to major facts about energy. The time period covered is 1973 to 1984, except for world energy data, which covers 1973 to 1983. Graphics are used to portray trends, shares, and locations of various energy sources and uses.

0208 Waste Management

REFER ALSO TO CITATION(S) 31254, 31673

29782 (NMERDI—2-73-4622) **Gas and oil production wastewater disposal alternatives for the San Juan Basin. Final report.** Zygmunt, S.J.; Andrews, T.L.; Siegel, J.H. (Delta H Engineering Ltd., Santa Fe, NM (USA)). Jun 1985. 110p. NTIS, PC A06/MF A01 - NMERDI-Univ. of New Mexico, 457 Washington SE, Albuquerque, NM 87108 . File Number DE85901566.

Oil and gas production in the San Juan Basin of New Mexico yields small quantities of water contaminated with salts, metals and hydrocarbons. The study compared alternative costs for lined pond evaporation, double walled tank evaporation, gas fired evaporation, deep well injection and various treatment methods. A hand held calculator program was written to predict evaporation from lined ponds. Data for pond design for the San Juan Basin was prepared.

29783 (PB—85-180297/XAB) **Composition and management of used oil generated in the United States.** Bider, W.L. (Franklin Associates, Prarie Village, KS (USA)). Nov 1985. 172p. NTIS, PC A08/MF A01.

The report summarizes information acquired by the EPA over the period of 1981-1984. Analytical results from over 1000 samples of various types of used oils are presented, and grouped by where the samples came from as well as the recycling method employed. Estimates are also presented concerning the number of facilities generating and processing used oil, as well as the amounts of used oil generated and managed in various ways.

0209 Environmental Aspects

29784 (NIPER—20, pp 343-352) **Diesel exhaust characterization.** 28 Feb 1985. NTIS, PC A16/MF A01. File Number DE85000122.

In NIPER annual report, 1984.

Particulate studies have involved processing extracted particulate samples from five light-duty diesel vehicles through a chromatographic scheme to separate the extracts into 10 fractions which were biologically tested. The biological data of the different fractions were evaluated to determine if the biological activity of the extract could be predicted using some measured variables in the particulate analysis. The results of these studies showed that the mutagenic activity was primarily concentrated in a fraction containing nitro-PAH compounds and the mutagenic activity for that fraction ranged from 42 to 90% of the total sample activity, yet the weight-percent of this fraction ranged from 6 to 23% of the total extract mass. The remaining mutagenic activity was found in other fractions containing polar compounds. The mutagenic activity of the particulate extracts from a vehicle fueled with the alternate fuel blends was 30 to 50% higher than particulate extracts using the reference fuel. An engine operating on jet fuel yielded particulate with significantly lower mutagenic activity. The emission particulate extractables were higher from the direct-injection engine. Evaluation of the results did not indicate any interaction of fuel, engine, or modal effect on emission level or biological activity of the extractable material.

29785 (NIPER—20, pp 77-85) **EOR environmental compatibility.** 28 Feb 1985. NTIS, PC A16/MF A01. File Number DE85000122.

In NIPER annual report, 1984.

A program was started to investigate and determine the environmental hazards associated with enhanced oil recovery (EOR). During the first year, process performance and potential environmental hazards of microbial EOR (MEOR) were investigated. The results of the first year's effort were a publication on the state of the art of MEOR, assembly of a microbial laboratory capable of performing MEOR coreflood experiments, a report on designing MEOR reservoir data bases, 35 microbial isolates for use in environmental studies, and a report on environmental hazards of MEOR. An opportunity to chair an international symposium on groundwater contamination and edit the papers for a prestigious standards publication was accepted.

29786 **(NMERDI—2-72-4628) Water use, conservation and wastewater treatment alternatives for oil refineries in New Mexico.** Timm, C.M. (Jacobs Engineering Group, Inc., Albuquerque, NM (USA)). May 1985. 199p. NMERDI, Suite M., 457 Washington SE, Albuquerque, NM 87108. File Number DE85901468.

This study analyzed the present operations, water use and wastewater treatment and disposal of the operating refineries in New Mexico. Alternatives for water conservation and wastewater reduction/treatment were evaluated for applicability and cost effectiveness. New Mexico refineries presently use from 10.6 to 39.1 gallons of water per barrel of crude oil and generate 6.5 to 25.4 gallons of wastewater per barrel of crude. All New Mexico refineries use either API or tilted plate separators for oil recovery followed by evaporation/percolation ponds. In comparison to national averages, New Mexico refineries have excessively high boiler and cooling tower blowdown rates. Better operational controls could reduce water use significantly. Also, the oil and grease concentration in the effluents are higher than the national average, indicating that better operational control is needed in this area as well. Several water savings alternatives including recycling water to the desalter, adding vacuum pumps to the vacuum unit and adding air coolers to the crude unit were recommended which would reduce water use by sixteen percent (16%). Due to the stringent discharge standards and pending hazardous waste regulations, it was found to be more cost effective to construct new, lined ponds than to add BAT. The cost to clean up existing ponds which were assumed to be hazardous waste TSDFs was also evaluated. Costs for removal and proper disposal of the refinery sludges could be as high as $600,000/acre of pond. Regardless of the water conservation treatment measures adopted, the existing ponds will still require cleanup which could result in the closure of the remaining refineries in New Mexico. 32 refs., 21 figs., 31 tabs.

29787 **(OCS/EIS/MMS—85-0032) Final environmental impact statement: proposed 1985 Outer Continental Shelf oil and gas Lease Sale No. 111, offshore the Mid-Atlantic states.** (Minerals Management Service, Vienna, VA (USA). Atlantic OCS Region). 1985. 824p. Minerals Management Service, Vienna, VA 22180. File Number TI85901498.

The proposed action is the offering of 3561 blocks (20 million acres) located from 50 statute miles (25 statute miles off North Carolina) to 140 statute miles offshore Rhode Island, New York, New Jersey, Delaware, Maryland, and Virginia for leasing in accordance with the Outer Continental Shelf Lands Act, as amended. The average water depths of these blocks range from 40 to 3200 meters. Sale No. 111 is tentatively scheduled for October 1985. Alternatives considered include a delay of the sale, canceling the sale (no action), and three deferral alternatives. The deferral alternatives include one concerning blocks in the surface-free zone for the NASA Wallops Island Flight Facility, one to protect the biota of submarine canyon areas, and one to protect the biota on blocks shoreward of the Gulf Stream below 36°N. Oil and gas activities on all blocks studied in this Final Environmental Impact Statement (FEIS) pose some risk to the environment. Mitigating measures which may reduce the risk have been identified. Areas of potential impact onshore are Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, Delaware, Maryland, Virginia, and North Carolina, and their coastal waters. Six maps of the Mid-Atlantic Outer Continental Shelf are included. These show the following: (1) lease status, coastal recreation and open space resources, potential hazards; (2) average surface circulation; (3) endangered species, major environmental geologic features and surficial bottom deposits; (4 & 5) selected domestic fish resources spring and summer distribution, and fall and winter distribution; and (6) petroleum related facilities and military operating areas. 473 refs., 32 figs., 56 tabs.

0210 Legislation And Regulation

REFER ALSO TO CITATION(S) 30100

29788 **(GAO/RCED—85-88) Issues surrounding continuation of the noncompetitive oil and gas lottery system.** (General Accounting Office, Washington, DC (USA). Resources, Community and Economic Development Div.). 4 Apr 1985. 56p. US General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877. File Number TI85901570.

Report to the Chairman, Committee on Interior and Insular Affairs, House of Representatives.

The Bureau of Land Management is responsible for the leasing of oil and gas mineral rights on over 300 million acres of public lands. Under the Mineral Leasing Act of 1920, lands with known oil and gas deposits are leased competitively. However, much more federal land is leased through a noncompetitive lottery system, which generates substantial receipts for the federal Treasury - about $250 million in filing fees for the 5-year period 1980-1984. The lottery system has been criticized since its 1959 inception for encouraging fraud, misleading the public, and generating insufficient revenues. On October 12, 1983, the program was suspended for 10 months because of recognized weaknesses in the system. This report highlights major issues surrounding the lottery program.

29789 **Department of Energy's participation in the International Energy Agency's recent worldwide oil-sharing test (allocation systems test - AST-4). Hearing before a Subcommittee of the Committee on Government Operations, House of Representatives, Ninety-Eighth Congress, First Session, September 22, 1983.** Washington, DC; Government Printing Office (1984). 507p.

Eight witnesses from state, federal, and international energy offices and organizations reviewed DOE's performance during a test of the International Energy Agency's (IEA's) oil-sharing program, which simulated a supply disruption and the effectiveness of international cooperation in sharing available supplies. Only the Reagan administration found the free market approach to the test a success, while IEA, the oil companies, the State Department, and parts of DOE questioned whether market forces could handle all the problems in a real situation, particularly whether national security might be in jeopardy. Witnesses debated both the performance of a free market and the structure of the simulation test itself. Additional letters, statements, and other material submitted for the record and six appendices follow the testimony.

0220 Transport, Pipelines, And Handling

REFER ALSO TO CITATION(S) 31325

0230 Properties

REFER ALSO TO CITATION(S) 29616, 29664, 29798, 29840, 31625

29790 (DOE/PC/60807—7) **Supercritical fluid chromatography/supersonic jet spectroscopy. Progress report, February 1, 1985-April 30, 1985.** Lee, M.L.; Goates, S.R. (Brigham Young Univ., Provo, UT (USA). Dept. of Chemistry). 1985. Contract FG22-83PC60807. 13p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85012539.

Supercritical fluid (SF) fractionations of a petroleum crude oil and a solvent refined coal heavy distillate (HD) were conducted. The flame ion detector (FID) uv chromatograms of the petroleum crude oil and SRC II HD on NH_2-modified silica with CO_2 at 40°C are shown in Figures 3 and 5, respectively. The gas chromatograms of the fractions are shown in Figures 4 and 6. Because this crude oil contained compounds with such a wide range of molecular weights, a chemical class separation was not possible on this column. However, for the fractionation of SRC II HD, the aliphatics and neutral aromatics eluted in the first fraction and the nitrogen compounds and high molecular weight neutral aromatics eluted in the second fraction. It was concluded that the FID system performed satisfactorily on the whole. Progress on supersonic jet spectroscopy has been inhibited this quarter by the need to temporarily vacate the spectroscopy lab for physical plant modifications. The investigators used this time to evaluate the experiment and their approach. Their initial spectroscopic results with naphthalene have demonstrated considerable improvement in spectral resolution by supersonic jet/supercritical fluid technique, but sensitivity has been lacking, and they have not yet achieved the same degree of jet cooling that has been demonstrated with conventional carrier gases. These problems are under investigation.

29791 (NIPER—20, pp 241-250) **Thermophysical and thermochemical properties of organic compounds derived from fossil substances.** 28 Feb 1985. NTIS, PC A16/MF A01. File Number DE85000122.

In NIPER annual report, 1984.

Thermodynamic studies are described on the thermophysical and thermochemical properties of organic oxygen compounds and on related hydrogen bonding fluids. Combustion calorimetric studies were completed on chroman, isochroman, and 4,5-dihydro-2,3-benzofuran. Condensed-phase heat-capacity and enthalpy measurements were completed on 2,3-benzofuran and isochroman, and vapor pressure studies were completed on 2,3-benzofuran. The results were used to test group-contribution thermodynamic-prediction methods and showed that the data base previously used for the development of the predictions is inadequate. As a concurrent part of the foregoing studies, equipment developments were made for all of the property measurements. A new platinum calorimeter was constructed, and progress was made on the construction of two new cryostats for condensed-phase heat-capacity measurements of reactive substances at temperatures from 4 to 523 K. New designs were developed for a combustion calorimetric system which will require one-tenth of the sample presently required but still provide the precision, 0.002%, and accuracy presently attained. New designs were also developed for a torsion-effusion vapor-pressure apparatus for the measurements on high molecular weight substances which cannot be studied with methods suitable for substances with high pressures. In the study of hydrogen-bonded fluids, a flow calorimetric system for direct measurement of enthalpies of vaporization and vapor-heat capacities was extensively modernized and automated, and calorimetric measurements were made on 3-methylpyrrolidine and 2-methylpiperidine with only partial success. For pressure-volume-temperature (PVT) studies, a suitable confinement system was designed and constructed to obtain measurements on methanol without decomposition, and final calibration of the system is well underway.

29792 (NIPER—20, pp 299-308) **Chemical characterization of heavy ends of light petroleum, of heavy petroleum, and of liquids derived from other fossil sources.** 28 Feb 1985. NTIS, PC A16/MF A01. File Number DE85000122.

In NIPER annual report, 1984.

Field ionization mass spectral sensitivities were determined for components in eight mixtures of aromatic hydrocarbons which included several compounds not previously studied. The results were inconclusive in that several sensitivity values were in close agreement with previous determinations and several values did not agree well. Aromatic fractions separated according to aromatic ring number from distillates of heavy petroleum are being characterized and evaluated for their suitability in determination of ultraviolet, gas chromatography/flame ionization detection, and mass spectral average response factors. Synchronous scanning fluorimetry and gas chromatography/mass spectral results were generally consistent with the ring number assignment for the monoaromatic, diaromatic, and three- and four-ring aromatic fractions examined to date. Methodology is being developed for fractionating acidic components of fuels according to compound class and analyzing the resulting fractions. Results so far indicate: (1) subfractionation of samples containing only distillable acids resulted in subfractions containing compound classes consistent with those predicted from preliminary work with model systems, (2) unsatisfactory results were obtained on acid concentrates from residue fractions using the ether-based solvent system which prompted the development of a chloroform-based solvent system for separations of residue acid concentrates, and (3) the major weakness of the overall method is the aqueous extraction of tetramethylammonium hydroxide from the resulting fractions because it is time-consuming and sometimes contributes to incomplete recovery of acids.

29793 (NIPER—20, pp 319-330) **Chemistry of contaminated petroleum fuels.** 28 Feb 1985. NTIS, PC A16/MF A01. File Number DE85000122.

In NIPER annual report, 1984.

As the proportion of lower quality petroleum crudes used for fuel generation increases, the level of nonhydrocarbons present also increases. One way of studying the effect of these components is to investigate current fuels that have become contaminated. This project involves contaminated distillate fuel of known initial quality and is partially sponsored by the US Navy. The research is planned to lead ultimately to a practical technique for the conversion of reclaimed product (RP) into naval distillate fuel (F-76). The first phase of the project, which is now completed, focused on the review of the literature and the available information on waste fuel processing. This information has been carefully reviewed, and the specific information required for the upgrading of RP to F-76 has been prioritized and presented in a report. Based upon these results, Phase II of the project has been initiated. In this phase experiments are being performed to determine the most practical upgrading process(es). This report summarizes the major accomplishments for both Phase I and II for FY1984 and presents preliminary results and conclusions. These include the compilation of an extensive bibliography of literature on waste hydrocarbon recycling, a ranking of possible reclamation technologies and the preliminary evaluation of a number of the technologies proposed in Phase I.

29794 (NIPER—20, pp 275-286) **Chemical characterization of heavy ends of light petroleum, of heavy petroleum, and of liquids derived from other fossil sources.** 28 Feb 1985. NTIS, PC A16/MF A01. File Number DE85000122.

In NIPER annual report, 1984.

Several fractions from the Venezuelan heavy petroleum, Cerro Negro, have been analyzed by high-resolution mass spectrometry. These include acid and base fractions from the 200°-425°C distillate, and base and aromatic neutral fractions from the 425°-550°C distillate. Using low-voltage, electron-impact spectra recorded earlier, elemental compositions were assigned to the ions in the spectra based on precise mass measurement. Carbon-number distributions and elemental analyses were calculated from the data, and the latter results were compared with those obtained from a conventional analysis. The acid fraction from the 200°-425°C distillate was found to consist predominantly of compounds in the following homologous Z series: C/sub n/H/sub 2n+z/N, C/sub n/H/sub 2n+z/O_3, C/sub n/H/sub 2n+z/O, and C/sub n/H/sub

2n+z/SO_2 in order of decreasing abundance. In the base fraction from the same distillate the predominant compounds were found in the series: C/sub n/H/sub 2n+z/N and C/sub n/H/sub 2n+z/NS. The data for the base fraction from the 425°-550°C distillate showed that this fraction consists primarily of compounds of the type C/sub n/H/sub 2n+z/N, C/sub n/H/sub 2n+z/NS, and C/sub n/H/sub 2n+z/NS_2. In the aromatic neutral fraction from the same distillate, compounds of the type C/sub n/H/sub 2n+z/S and C/sub n/H/sub 2n+z/, i.e. hydrocarbons, were found as the principal components.

29795 (NIPER—20, pp 309-318) **Fuel trends and analyses.** 28 Feb 1985. NTIS, PC A16/MF A01. File Number DE85000122.

In NIPER annual report, 1984.

Five major fuel survey reports have been published and distributed during the past year. These surveys define the quality of fuels available in the current market place. Abstracts of each of the surveys are presented with tables of summary information. The five reports are for diesel fuels, motor gasolines (winter and summer), aviation fuels and heating oils. A report on long-term trends in fuel properties was prepared.

29796 (NIPER—20, pp 331-336) **Diesel fuel quality criteria.** 28 Feb 1985. NTIS, PC A16/MF A01. File Number DE85000122.

In NIPER annual report, 1984.

This program is concerned with examining influences on engine performance of diesel fuel parameters that are affected by increased utilization of alternative feedstocks. Tests were conducted on two Caterpillar heavy-duty engines. Ranges in fuel properties--distillation characteristics and aromaticity--were selected as parameters for a fuel matrix. Particulate samples were collected in large 20- by 20-inch and 40- by 40-inch filters. In the first of the projected runs, two fuels were utilized: the No. 2-D diesel reference fuel and a high-aromatic blend containing light-cycle oil. Results from both engines show increased hydrocarbon and particulate mass emissions with use of the highly aromatic light-cycle oil blend.

29797 (NIPER—20, pp 337-342) **Direct utilization of aromatic feedstocks.** 28 Feb 1985. NTIS, PC A16/MF A01. File Number DE85000122.

In NIPER annual report, 1984.

Increased use of heavy crudes in the refining industry has produced increased amounts of aromatic components in the distillate fuels resulting in poor diesel fuel quality. A research program was initiated to evaluate the potential of using in gasolines a portion of the heavy aromatics (up to 500°F cut) from coal-derived and heavy-petroleum crudes due to the expected high-octane quality of this fraction. Data were generated on exhaust emissions, vehicle driveability, and fuel octane quality using 10 and 25% of the material blended with gasoline. Engine durability was examined using a 10% blend of the heavy aromatic material with gasoline. Test results suggest a significant adverse effect on exhaust emissions and driveability using 25% concentrations of the material in gasoline but only minor effects using 10% concentrations. Octane quality of the materials was determined to be essentially equivalent to the base gasoline. Engine durability testing suggested significantly adverse engine-deposits formation in a 2,000-mile urban duty accumulation test.

0240 Storage

29798 (DOE/FE—0048) **Overview on assessment of crude oil and refined product quality during long-term storage.** Giles, H.N.; Bowden, J.N.; Stavinoha, L.L. (USDOE Assistant Secretary for Fossil Energy, Washington, DC. Strategic Petroleum Reserve; Southwest Research Inst., San Antonio, TX (USA). Army Fuels and Lubricants Research Lab.). Jun 1985. 43p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85012754.

This report presents the findings of a number of studies on the qualitative effects on petroleum resulting from prolonged storage primarily in deep underground caverns, but also in aboveground tanks. These studies comprised a literature survey, discussions with scientific and technical personnel in various petroleum companies, and a comprehensive laboratory investigation of samples from several strategic reserve sites in West Germany. It is demonstrated conclusively that both crude oil and refined products can be stored for prolonged periods without undergoing deleterious changes in quality. The most practical and economic mode of storage is in caverns in salt deposits. Moisture is likely the single most significant contributor to petroleum degradation because it will harbor microorganisms and fungi which metabolize hydrocarbons. Long-term storage stability can be enhanced by selecting products which are inherently stable and are additive treated. The storage stability of the product should be thoroughly evaluated, and a monitoring program instituted to periodically assess the quality of the petroleum in storage. 40 refs., 13 figs., 8 tabs.

29799 (DOE/OR/21403—T1) **Design review for Strategic Petroleum Reserve Office: Big Hill, Texas; New Orleans, Louisiana. Appendix.** (Bechtel Petroleum, Inc., Houston, TX (USA)). Feb 1984. Contract AC05-84OR21403. 315p. NTIS, PC A14/MF A01. File Number DE85012881.

The Appendix consists of conference notes, letters, and logs of the various documents received by Bechtel to conduct the Design Review. The drawing logs are segregated by Contract Package. The logs for specifications, calculations, pre-design documents, and deviation requests apply to all packages.

29800 (DOE/OR/21403—T2) **Design review for Strategic Petroleum Reserve office, Big Hill, Texas, New Orleans, Louisiana.** (Bechtel Petroleum, Inc., Houston, TX (USA)). Feb 1984. Contract AC05-84OR21403. 419p. NTIS, PC A18/MF A01; 1; GPO Dep. File Number DE85012545.

The Big Hill Strategic Petroleum Reserve storage site is designed to store 140 million barrels of oil in underground storage caverns. The major facilities of the Big Hill Strategic Petroleum Reserve storage site are: the main operations area; the storage cavern area; the Raw Water Intake Structure at the Intracoastal Waterway; the raw water pipeline between the Big Hill operations area and Raw Water Intake Structure; the brine disposal pipeline from the Big Hill complex to 3-1/2 miles into the Gulf of Mexico; and, the crude oil pipeline between the Sunoco Terminals in Nederland and Big Hill Complex. These facilities are designed to solution mine the storage caverns from naturally occurring salt domes below the Big Hill complex site, as well as, to transport the crude oil in and out of the caverns to/from the Sunoco Terminals. Bechtel Petroleum, Inc. through Bechtel Advanced Technologies has been engaged to conduct a review of the design of the Big Hill facilities. The purpose of this design review is to audit design and construction documents to: ensure that the design complies with established design criteria; ensure the constructability of the design; and ensure that the interfaces between the construction packages are adequate. To this end, Bechtel was provided with construction contract packages, most design calculations and various pre-design documents. A summary of the scope of each contract package can be found on Table I.

29801 (GAO/RCED—85-111) **Status of Strategic Petroleum Reserve activities as of March 31, 1985.** (General Accounting Office, Washington, DC (USA). Resources, Community and Economic Development Div.). 15 Apr 1985. 36p. US General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877. File Number TI85901572.

The Department of Energy reported that the Strategic Petroleum Reserve contained 461.6 million barrels of oil on March 31, 1985. During the second quarter of fiscal year 1985, about 11.1 million barrels of oil were added for a fill rate of 123,000 barrels per day. This report discusses the progress being made in filling, developing, and operating the Reserve. It also discusses other events and activities affecting the Reserve that occurred during the second quarter of fiscal year 1985. 11 tabs.

29802 (SAND—84-1957) **Preliminary SPR thermal model description and results for WH-11 and BM-4.** Tomasko, D. (Sandia National Labs., Albuquerque, NM (USA)). May 1985. Contract AC04-76DP00789. 41p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85013171.

Fluid temperatures within the Strategic Petroleum Reserve caverns are calculated using a modified one-dimensional, time-dependent Rahm-Walin equation coupled to a two-dimensional, time-dependent heat conduction equation in the salt massif. Comparisons of model results with experimental data from West Hackberry Cavern 11 and Bryan Mound Cavern 4 are very good for up to eight years of cavern life. 13 refs., 19 figs., 7 tabs.

29803 **(SAND—85-0045) Analysis of drag reducing agents for use at the Strategic Petroleum Reserve site at West Hackberry, Louisiana.** Hinkebein, T.E. (Sandia National Labs., Albuquerque, NM (USA)). May 1985. Contract AC04-76DP00789. 50p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85013170.

An analysis method for evaluating the use of polymeric drag reducing agents (DRA) within the Strategic Petroleum Reserve brine disposal pipelines has been formulated. This method is based upon a detailed flow model describing the flow of solutions with DRA through the brine pipeline at West Hackberry, Louisiana. The verification of this model is confirmed by the Southwest Research Laboratory data. This model indicates that the drag reduction effect is dependent on polymer solution type and concentration as well as the fluid wall shear stress and the pipe roughness. For the West Hackberry pipeline, it is projected that a 20% flow increase is attainable with the best polymers. Further drag reducing agent tests are proposed to allow a more accurate prediction of flow improvement. 12 refs., 21 figs., 3 tabs.

0250 Combustion

REFER ALSO TO CITATION(S) 31324, 31338, 31345

29804 **(LA-UR—85-1728) KIVA computer program for multidimensional chemically reactive fluid flows with fuel sprays.** O'Rourke, P.J. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 17p. (CONF-8505150—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE85012730.

From Symposium on numerical simulation of combustion phenomena; Sophia-Antipolis, France (21 May 1985).

This paper is a presentation of the capabilities of the KIVA computer program, which was written to calculate both two- and three-dimensional chemically reactive fluid flows. KIVA solves by finite-difference techniques the unsteady equations for a multi-component, chemically reactive mixture of ideal gases, together with those for an evaporating liquid spray. Although it was written with applications to internal combustion engine research in mind, with modification KIVA can be applied to a variety of other combustion and two-phase flow problems. This paper emphasizes the differences between KIVA and the well-known CONCHAS-SPRAY computer program and gives some advantages and disadvantages of the numerical methodology in KIVA. We illustrate the capabilities of the program by describing the results of numerical test problems.

03 NATURAL GAS

REFER ALSO TO CITATION(S) 29613

0301 Reserves

REFER ALSO TO CITATION(S) 29742, 29743

0302 Geology And Exploration

REFER ALSO TO CITATION(S) 29744, 29745

29805 **(DOE/MC/20342—1838) Effects of water and stress upon permeability to gas of paludal and coastal sands: USDOE multiwell experiment.** Randolph, P.; Soeder, D.J.; Chowdiah, P. (Institute of Gas Technology, Chicago, IL (USA)). Feb 1985. Contract AC21-83MC20342. 211p. NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE85008607.

Detailed parametric analyses of the effects of (1) net stress on the rock matrix and (2) fractional water saturation of pore volume upon permeability to gas were performed for four samples from each of two Mesa Verde depositional environments (paludal and coastal). This included measurement of the Klinkenberg parameters for the two net stresses for each sample and calculation of flow path characteristics (width and upper limit of tortuosity). The work simultaneously involved three categories of activity: (1) measuring matrix parameter values for computer simulation of production from DOE's MWX experiment; (2) improving understanding of tight sandstone pore morphology and the physical principles that control gas content and gas transport in the in-situ reservoir; and (3) advancing laboratory core analysis technology such that results are more likely to provide a valid description of the undisturbed in-situ reservoir from which the samples were obtained. Conclusions, implications of results obtained, and recommendations for future action on each of these topics are presented under the following subheadings: matrix parameters for computer simulation of production; pore morphology and the physics of fluid transport; and advances in core analysis technology. 9 refs., 38 figs., 10 tabs.

0303 Drilling, Production, And Processing

REFER ALSO TO CITATION(S) 29743

0304 Products And By-products

29806 **(PB—85-183697/XAB) Heat-of-mixing experiments for liquefied gases. Annual report, November 1983-October 1984.** Zollweg, J.A.; Streett, W.B. (Cornell Univ., Ithaca, NY (USA). School of Chemical Engineering). Dec 1984. 17p. NTIS, PC A02/MF A01.

See also PB84-215094.

Calorimetric measurements of the excess enthalpy in the systems nitrogen/carbon monoxide at 83.82 K and carbon monoxide/methane at 91.3 K were performed in a batch-mixing calorimeter. The observed equimolar excess enthalpy for N_2/CO (41.2 + or - 1.2 J/mol) is consistent with the temperature variation of G(sup E) deduced from vapor-liquid equilibrium measurements. It is much larger, though, than one would predict from conformal solution theories with Lorentz-Berthelot mixing rules. Thus it appears that the excess entropy is positive in methane-rich mixtures.

0305 Health And Safety

29807 **(PB—85-184083/XAB) Flame-acceleration mechanisms under conditions of partial confinement. Final report, February 1983-August 1984.** Strehlow, R.A.; Ormsbee, A.I.; Yip, T.W.G.; Reichenbach, S.H. (Illinois Univ., Urbana (USA). Dept. of Aeronautical and Astronautical Engineering). Sep 1984. 132p. NTIS, PC A07/MF A01.

See also PB83-244012.

A technique has been developed to quantify the violence of the interaction of a flame with a vortex in the flow. The vortex was generated in the wake of a corner or at the trailing edge of a plate by causing a premixed flame to act as a piston in a channel. When the flame exited the channel it immediately interacted with the vortex. The apparatus has cylindrical symmetry and the output of sensitive pressure transducers was used with acoustic monopole theory to determine the violence of the flame-vortex interaction process as a function of channel dimensions and normal burning velocity of the combustible mixtures. This flow was modeled by Dr. Pam Barr of the Sandia Livermore National Laboratories and the violence of the interaction was analyzed in terms of the calculated vorticity Reynolds number of the vortex. A shock tube was used to generate vortices and observe the breakdown process, to determine how a maturing vortex breaks down to become turbulent. The results of this study are also presented.

0306 Marketing And Economics

REFER ALSO TO CITATION(S) 29781, 29787, 31138, 31172

29808 Changes in policies affecting US natural gas trade. Levine, L.B. (Dept. of Energy's Economic Regulatory Administration (ERA), Washington, DC). *Journal of Energy and Development;* 10: No. 1, 117-120(Aut 1984).

Encouraging signs can be found in the beginnings of competition among suppliers of Canadian gas for US markets. Several new exporters have appeared, firms which have not been involved in exporting directly before; more appear to be on the horizon. As additional competition surfaces in areas not seen before, this trend will be observed with interest. In addition, in the area of short-term or spot sales, we see new competitive pressures asserting themselves as new exporters in Canada and importers in the US participate in the gas trade. Industrial users and US distribution companies are taking advantage of market opportunities to obtain more competitive gas supplies. The new regulatory procedures at ERA should be able to give the freedom to continue deriving benefits from this opportunity in a timely manner.

0307 Waste Management

REFER ALSO TO CITATION(S) 29782

0308 Environmental Effects

REFER ALSO TO CITATION(S) 29787

29809 (N—85-15926) Risks in the transport and storage of liquefied natural gas. Sub-project 5-2: investigation into building damage. Gouwens, C.; Dragosavic, M. (UKAEA Risley Nuclear Power Development Establishment). 1984. 32p. British Library Lending Div., Boston Spa, England.

The large reserves and increasing use of natural gas as a source of energy have resulted in its storage and transport becoming an urgent problem. Since a liquid of the same mass occupies only a fraction of the volume of a gas, it is economical to store natural gas as a liquid. Liquefied natural gas is stored in insulated tanks and also carried by ship at a temperature of -160 C to 170 C. If a serious accident allows the LNG to escape, a gas cloud forms. The results of a possible explosion from such a gas cloud are studied. The development of a leak, escape and evaporation, size and propagation of the gas cloud, the explosive pressures to be expected and the results on the environment are investigated. Damage to buildings is examined making use of the preliminary conclusions of the other sub-projects and especially the explosive pressures.

0309 Artificial Stimulation

REFER ALSO TO CITATION(S) 29695

29810 (RISO-M—2416) Simulation of enhanced oil recovery methods in Danish oil and gas reservoirs. A preproject. Bech, N. (Risoe National Lab., Roskilde (Denmark)). Sep 1984. 210p. NTIS (US Sales Only), PC A10/MF A01. File Number DE85750795.

A literature study has been performed in order to provide the basic information required to design a reservoir simulation model, specifically suited for studies concerning the application of enhanced oil recovery in Danish oil and gas reservoirs. The report contains a brief introduction to the concept of reservoir simulation, a classification of existing reservoir simulators with respect to area of application, mathematical and numerical models, and miscellaneous features, a characterization of Danish oil and gas reservoirs from the simulation point of view, a listing of enhanced oil recovery methods that are considered potential candidates for use in Danish reservoirs, and a discussion of simulator requirements and recommendations regarding computer code development. The proposal involves a fully compositional, isotherm, finite difference simulator.

29811 (SAND—85-0990C) Comprehensive fracture diagnostics experiment. Part II. Comparison of seven fracture azimuth measurements. Smith. M.B.; Ren, N.K.; Sorrells, G.G.; Teufel, L.W. (Amoco Production Co., Chicago, IL (USA); Dowell Schlumberger (USA); Teledyne Geotech, Dallas, TX (USA); Sandia National Labs., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 16p. (CONF-8505115—5). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85011707.

From SPE/DOE symposium on low permeability reservoirs; Denver, CO, USA (19 May 1985).

A great deal of effort has been devoted recently to find geophysical techniques for measuring the hydraulic fracture azimuth. This paper discusses a comparison of seven different measurements used to determine the azimuth in a sandstone formation at a depth of 1000 ft (320 m). The azimuth was determined as N95E, but significant differences existed between some of the results. This is of fundamental importance since in developing new measurements, the limits of these must be found and honored. Of particular interest are the results from microseismic monitoring. The lack of results suggests that remote (e.g., surface) monitoring for seismic events may be impractical for normal, sedimentary, hydrocarbon-bearing formations. 33 refs., 6 figs., 3 tabs.

0310 Legislation And Regulation

REFER ALSO TO CITATION(S) 29788

0320 Transport, Pipelines, And Handling

29812 (PB—85-177087/XAB) Effectiveness of cathodic protection. Annual report, January-December 1981. Barlo, T.J.; Thompson, N.G.; Payer, J.H. (Battelle Columbus Labs., OH (USA)). Apr 1983. 318p. NTIS, PC A14/MF A01.

See also PB85-169324.

Present practices to design, install, maintain, and monitor cathodic-protection systems on gas-distribution piping were reviewed based upon interviews with personnel from 32 gas-distribution and cathodic-protection companies. The present practices were judged to be based upon good engineering practices. Deficiencies in presently available monitoring and maintenance methods were identified. Future trends in cathodic protection and technological needs were also discussed.

0330 Properties

REFER ALSO TO CITATION(S) 29806

0340 Combustion

REFER ALSO TO CITATION(S) 29807, 31324, 31395, 31721, 31722

0350 Storage

REFER ALSO TO CITATION(S) 31396

04 OIL SHALES AND TAR SANDS

REFER ALSO TO CITATION(S) 29613

29813 (DOE/ER/60036—T2-Vol.1) Studies of the Scottish oil shale industry. Volume 1. History of the industry, working conditions, and mineralogy of Scottish and Green River formation shales. Final report. Louw, S.J.; Addison, J. (Institute of Occupational Medicine, Edinburgh (UK)). Mar 1985. Contract AC02-82ER60036. 101p. (IOM-TM—85/2). NTIS, PC A06/MF A01; GPO Dep. File Number DE85013323.

This report (in 3 volumes) describes the now defunct Scottish oil shale industry and effects on the health of its workers. The first volume recounts in brief the technological history of the industry's mines and retorts. This is based on a survey of available documents which, together with first-hand accounts from interviews with surviving shale workers, have also been used to make an assessment of dust conditions and of safety precautions in the industry. It also includes a mineralogical characterization of Scottish shales compared with those from the Green River formation in the Colorado Rockies. This industry had a life span of some 112 years from its foundation in 1850, when James 'paraffin' Young constructed a facility to retort and refine cannel coal near Bathgate, West Lothian. At its peak, in 1913, the industry employed 10,000 people though economic factors forced its subsequent gradual decline and the final blow was struck when the differential excise duty was withdrawn in 1962. 40 refs., 16 figs., 10 tabs.

0401 Reserves And Exploration

REFER ALSO TO CITATION(S) 31137

29814 (DOE/METC—85/13, pp 36-57) **Major tar sand and heavy oil deposits of the US.** Kuuskraa, V.A.; Hammershaimb, E.C.; Paque, M. (Lewin and Associates, Inc., Washington, DC). Feb 1985. NTIS, PC A99/MF A01. File Number DE85001994. (CONF-8406127—).

From WRI/DOE tar sands symposium; Vail, CO, USA (27 Jun 1984).

A current assessment of US tar sand resources is presented, based on an independent appraisal of all tar sand deposits with 100 million or more barrels in-place and a review of published data for minor tar deposits (having between 10 and 100 million barrels in-place). The US tar sand resource is estimated to be 54 billion barrels distributed in eleven states. Of this, 22 billion barrels are classified as a measured resource and the remainder, 32 billion barrels, are classified as speculative. This resource estimate is considerably larger than reported in previous studies which had estimates ranging from 5.5 to 36.4 billion barrels. The distribution of the US tar sand resource by state is shown. In addition, over 1100 heavy oil deposits, an important but only partly developed energy resource, are described.

29815 (DOE/METC—85/13, pp 90-137) **Geology and resources of the Tar Sand Triangle, southeastern Utah.** Dana, G.F.; Oliver, R.L.; Elliott, J.R. (Western Research Institute, Laramie, Wyoming). Feb 1985. NTIS, PC A99/MF A01. File Number DE85001994. (CONF-8406127—).

From WRI/DOE tar sands symposium; Vail, CO, USA (27 Jun 1984).

The Tar Sand Triangle is located in southeastern Utah between the Dirty Devil and Colorado Rivers and covers an area of about 200 square miles. The geology of the area consists of gently northwest dipping strata exposed in the box canyons and slopes of the canyonlands morphology. Strata in the area range in age from Jurassic to Permian. The majority of tar sand saturation is found in the Permian White Rim Sandstone Member of the Cutler Formation. The White Rim Sandstone Member consists of a clean, well-sorted sandstone which was deposited in a shallow marine environment. Resources were calculated from analytical data from the three coreholes drilled by the Laramie Energy Technology Center and other available data. The total in-place resources, determined from this study, are 6.3 billion barrels. Previous estimates ranged from 2.9 to 16 million barrels. More coring and analyses will be necessary before a more accurate determination of resources can be attempted.

29816 (DOE/METC—85/13, pp 138-140) **Results of the DOE-OGS tar sand coring program, south-central Oklahoma.** Harrison, W.E.; Burchfield, M.R. (Oklahoma Geological Survey, Norman). Feb 1985. NTIS, PC A99/MF A01. File Number DE85001994. (CONF-8406127—).

From WRI/DOE tar sands symposium; Vail, CO, USA (27 Jun 1984).

A coring program to evaluate the tar sand potential of specific deposits in Carter and Murray Counties, Oklahoma is discussed. This cooperative efforts resulted in resource evaluation of the Sulphur deposit in Murray County and the South Woodford and Overbrook deposits in Carter County. A fourth site, the Dougherty deposit in Murray County, was assessed on the basis of field relations and surface samples. The Sulphur and Dougherty tar sand deposits were actively mined until 1958 and 1960, respectively, and cumulative production, for both sites, is estimated at 2.5 million tons. The Sulphur deposit was evaluated by a total of 56 industry and DOE-OGS boreholes with the following results. The deepest occurrence of bitumen at Sulphur was an industry borehole which recovered bitumen-impregnated Oil Creek Sandstone cuttings from 2600-2700 feet. Bitumen determinations of industry cores ranged from 0.9 to 12.9% (wt.) while the recovered DOE-OGS cores varied from 0.8 to 4.9%. Specific gravity of the extracted bitumen was 1.043 g/cc. Permeabilities of selected core samples, after Dean-Stark Distillation, were between 1 and 7 darcies; porosity varied from 22.0 to 28.1%. The measured in-place bitumen, as defined by industry and DOE-OGS boreholes, was calculated to be 34 million barrels. An additional 12.5 million barrels is thought to be probable at the Sulphur site. The Dougherty deposit is estimated to contain 3.6 million barrels of probable bitumen.

0402 Site Geology And Hydrology

REFER ALSO TO CITATION(S) 29813

0403 Drilling, Fracturing, And Mining

REFER ALSO TO CITATION(S) 29852

29817 (DOE/METC—85/13, pp 141-148) **Downhole hydraulic mining system.** Wagner, C.G.; Hodges, E.L. (California Tar Sands Development Corp., Orange). Feb 1985. NTIS, PC A99/MF A01. File Number DE85001994. (CONF-8406127—).

From WRI/DOE tar sands symposium; Vail, CO, USA (27 Jun 1984).

The downhole hydraulic mining system is designed to exploit deposits of oil-bearing sands that are not economically producible using current oilfield or mining technology. In most cases, the hydrocarbon in the reservoir is too viscous to flow into the wellbore naturally and application of heat (steam combustion gases) are inefficient or not feasible. Thus no oil is produced from the deposits. Through a borehole drilled from the surface, the hydraulic mining system can extract sands occurring at depths from 100 to 600 feet. The hydraulic tool utilizes high pressure water jets to cut the subterranean formation and create a sand/water slurry that is pumped to the surface where the oil can be concentrated and separated from waste materials. After separation the waste rock is reinjected into the underground cavern from which it was mined and the water can be cleaned and recycled into the mining systems. The hydraulic mining system has several inherent advantages, i.e., minimal environment impact and land disfigurement, application to deposits too deep for strip mining yet too shallow for heat, high percentage of oil recovery from in-place reserves, and high mobility of system.

0404 Oil Production, Recovery, And Refining

REFER ALSO TO CITATION(S) 29850

29818 (DOE/LC/10763—1706) **High temperature mineral alteration of oil shale from an in-situ retorting experiment. Final report, September 1, 1981-May 15, 1983.** Howatson, J. (Wyoming Univ., Laramie (USA). Dept. of Chemistry). Mar 1984. Contract AS20-81LC10763. 31p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85004982.

This project was undertaken to determine the effects of in-situ processing on oil shale minerals. The "burn" from which the samples were obtained was carried out by Geokinetics Inc. at a site 112 km south of Vernal, Utah. Selected samples of a core which was drilled near the center of the burn were examined by Fourier transform spectroscopy. A sample of the hottest section of the "burn" core was also examined by scanning electron microscopy. For comparison core samples from a control hole drilled about 30 m outside the retorted zone were used in a series of laboratory retorting experiments from 600 to 1000°C. The products from the latter were examined by X-ray powder diffraction, Fourier transform infrared spectroscopy and scanning electron microsopy. Data from the above exploratory experiments led to tentative conclusions about the temperature distribution in the "burn" core. 1 ref., 14 figs.

29819 (DOE/METC—85/13, pp 645-667) **Relative supply prices for non-conventional Canadian domestic oil.** Chow, E.S.Y. Feb 1985. NTIS, PC A99/MF A01. File Number DE85001994. (CONF-8406127—).

From WRI/DOE tar sands symposium; Vail, CO, USA (27 Jun 1984).

Oil supply from conventional sources in Western Canada has been declining as reserves have been depleted. In 1983, supply from these sources accounted for about 91% of total Canadian domestic requirements (1,353,000 bbl/d), but is expected to decline to about 45% by the year 2000. Currently, Canada is self-sufficient with a small surplus of 100,000 bbl/d being exported. However, with the rapid decline in conventional supply, this situation could change if new oil supplies are not developed in the near future. The supply prices and the relative commercial attractiveness of five non-conventional Canadian sources of oil are discussed. These are: in-situ enhanced bitumen and heavy oil production from the oil sands and heavy oil deposits in Alberta and Saskatchewan; combined in-situ production and upgrading of bitumen and heavy oil; integrated mining/upgrading synthetic production from the Athabasca oil sands; light oil production from the East Coast offshore frontier; and light oil production from the Beaufort Sea and Mackenzie Delta. A short description of the definition and use of supply prices is given, followed by a discussion of the relative attractiveness of oil production from these five sources.

29820 (DOE/METC—85/13, pp 150-164) **Process development in in-situ recovery of bitumen from oil sands.** Nguyen, D.M.; Prowse, D.R.; Heidrick, T.R. (Alberta Research Council, Edmonton). Feb 1985. NTIS, PC A99/MF A01. File Number DE85001994. (CONF-8406127—).

From WRI/DOE tar sands symposium; Vail, CO, USA (27 Jun 1984).

The Alberta Research Council has played a major role in developing the technology of recovering bitumen from Canada oil sands deposits. Initially the Karl Clark Hot Water process was developed for oil recovery from mined sands. More recently, efforts have focused on in situ methods suitable for deposits that are too deep to be profitably mined. The methodology involves both physical and numerical models. A recovery process is first characterized in physical simulators where recovery mechanisms are identified and studied. Mathematical representation of the process is then built into a numerical model along with measured physical parameters. The model, once validated by physical simulator results, is used to project the performance of the process in a field pilot situation. A description of the various physical and mathematical models are given along with the latest development in parameter measurements. The interlocking and complimentary roles of physical, mathematical models and parameters in the development of recovery processes are discussed.

29821 (DOE/METC—85/13, pp 165-185) **Physical simulator for horizontal well.** Coates, R. (Alberta Research Council, Edmonton). Feb 1985. NTIS, PC A99/MF A01. File Number DE85001994. (CONF-8406127—).

From WRI/DOE tar sands symposium; Vail, CO, USA (27 Jun 1984).

Laboratory simulation of a steam stimulation process using a horizontal well implanted into a tar sands formation was required in order to support field projects. Use of liquid solvents and non-condensable gases as additives, in conjunction with steam was regarded as another part of the experimental study. A double walled, 1 m long, pressurized Hassler-type cell was designed in order to simulate overburden pressure on the tar sands. Actual tar sand was used and packed around a scale-reduced horizontal well. The major subsystems of the physical simulator, the complex data processing, and the software used to compare different runs are described.

29822 (DOE/METC—85/13, pp 187-204) **Laboratory simulation of bitumen recovery by steam stimulation of horizontal wells.** Toma, P.; Redford, D.; Livesey, D. (Alberta Research Council, Edmonton). Feb 1985. NTIS, PC A99/MF A01. File Number DE85001994. (CONF-8406127—).

From WRI/DOE tar sands symposium; Vail, CO, USA (27 Jun 1984).

A laboratory investigation into the variable parameters which influence production of bitumen from a horizontal well was carried out. A reduced scale model of a portion of a horizontal well in an oil sand formation was reproduced in the laboratory. A double walled, pressurized Hassler-type cell was used to simulate overburden pressure on the oil sands. Actual Athabasca oil sand was used. The simulator was fully instrumented and a cyclic stimulation operating procedure was used to produce the bitumen. Steam-alone and steam in conjunction with solvents and noncondensible gases were tested. Alternate production schemes were studied and variations in the completion of the well were made. Observations made during fourteen different experiments are summarized. A linear regression model using nine parameters measured during the runs is presented. This model correlates recovery with: the heat injected, axial pressure loss, percent of slot area in the well, the grain size of the oil sands used, the initial rate of recovery, and the type of additives used with steam. The relative importance of each of these parameters on bitumen recovery is quantified and discussed. Of special interest is a model of bitumen recovery which involves a radial and an axial driving mechanism. The radial mechanism relates recovery of bitumen to bulk condensation and flashing of the steam. The axial driving mechanism is related to pressure drop encountered by steam and liquids flowing through a long open well or a natural fracture. The relative magnitude and the influence of these two mechanisms on recovery is discussed.

29823 (DOE/METC—85/13, pp 205-230) **Laboratory investigation of the steam displacement process in a Utah tar sand.** Romanowski, L.J. Jr.; Thomas, K.P. (Western Research Institute of the Univ. of Wyoming Research Corp., Laramie). Feb 1985. NTIS, PC A99/MF A01. File Number DE85001994. (CONF-8406127—).

From WRI/DOE tar sands symposium; Vail, CO, USA (27 Jun 1984).

Laboratory experiments are being conducted to study the potential of high pressure (350-1000 psig) steam displacement as an oil recovery process for Utah tar sand. These one-dimensional displacement experiments are designed to identify the relationships between the recovery efficiency and the processing conditions for two grades of tar sand representing different reservoir properties. The processing variables are the steam flowrate and initial tar sand preheat temperature; the controlled reservoir properties are the saturated permeability, porosity, bulk density, and the initial oil saturation. Crushed samples of tar sand were uniformly and consistently packed to physical properties closely resembling reservoir conditions. This was accomplished using an automated pneumatic-hydraulic tube packing apparatus. Tar sand containing 7.7 or 11.4 wt.% bitumen was packed to permeabilities ranging from 70-1100 millidarcies with oil saturations of 45-70% of pore volume (PV). The corresponding porosity ranges from 32-36%. Preheat temperatures from 215-475°F were initially established before saturated steam was injected at flow rates of 4.5-14.5 cc/min with a controlled backpressure of 360-390 psig. Results are presented from fifteen experiments, including the determination of various chemical and physical properties of the bitumen and the thermally produced oils. In addition, results and operating conditions related to the automated tube packing apparatus are discussed.

29824 (DOE/METC—85/13, pp 231-248) **Use of CO_2 with steam in bitumen recovery from oil sands: effect of injection strategies.** Nasr, T.N.; Nguyen, D.M.; Prowse, D.R. (Alberta Research Council, Edmonton). Feb 1985. NTIS, PC A99/MF A01. File Number DE85001994. (CONF-8406127—).

From WRI/DOE tar sands symposium; Vail, CO, USA (27 Jun 1984).

Studies have been carried out at the Alberta Research Council to investigate the use of steam and steam-additive processes for the recovery of bitumen from oil sand reservoirs. Results are presented from experiments in which steam-CO_2 was utilized in a three-dimensional, 2-well physical simulator. Three injection modes were investigated. These included continuous co-injection, cyclic co-injection/drawdown and a combination of CO_2 injection/soaking and cyclic steaming. The influence of injection modes on recovery was assessed. In all cases studied, the addition of CO_2 to steam resulted in improved utilization of injected energy. The improved oil recovery is also believed to be due to an improved conformance of the process rather than a lower residual bitumen saturation in the swept zone. Solution gas drive would appear to be the major beneficial mechanism in steam-CO_2 cyclic processes. This is demonstrated by a much higher recovery during pressure depletion cycles. The study indicates that, on the basis of unit weight of injected steam or injected energy, the CO_2 injection/soaking mode appears to be superior to all other modes. In this latter mode, time sequencing between CO_2 injection/soaking and cyclic steaming is found to play an important role in the final recovery. Better recovery was obtained in one particular sequence even though a much lower steam injection rate was used.

29825 (DOE/METC—85/13, pp 263-290) **Heavy oil from Kentucky tar sands via a wet combustion process.** Ward, C.E.; Ward, G.D. (Ward Douglas and Company, Inc., Marbledale, CT). Feb 1985. NTIS, PC A99/MF A01. File Number DE85001994. (CONF-8406127—).

From WRI/DOE tar sands symposium; Vail, CO, USA (27 Jun 1984).

While the world resource base of tar sands, bitumen or heavy oil is extremely large, improved technology is needed to effectively develop this resource base as a source of petroleum products. The development of an improved in situ wet combustion process for the production of heavy oil from tar sands in the Big Clifty formation of Western Kentucky is discussed. A one acre inverted 7-spot pattern was constructed in the summer and fall of 1981, and through March of 1983 6005 barrels of 10 API oil were produced, representing 22.5% of the oil-in-place on the one acre pattern. Very satisfactory production rates and air/oil ratios were achieved. Ultimate recovery using this improved wet combustion technology is estimated at approximately 50% of oil-in-place. Heavy oil production costs, including investment amortization and interest, of $13-$17/barrel are projected for production of heavy oil from the Kentucky tar sands using this approach. A commercial facility in Edmonson County based on improved technology developed from the pilot data is being planned. This project, to be built in stages, will consist initially of five 1000 B/D modules for a total capacity of 5000 B/D. The technical approach used on this project should have significant potential for application to other heavy oil or bitumen deposits.

29826 (DOE/METC—85/13, pp 291-343) **Application of TG concepts to in-situ combustion processes in tar sands.** Wayland, J.R.; Lee, D.O.; Massis, T.M. (Sandia National Labs., Albuquerque, NM). Feb 1985. NTIS, PC A99/MF A01. File Number DE85001994. (CONF-8406127—). Contract AC04-76DP00789.

From WRI/DOE tar sands symposium; Vail, CO, USA (27 Jun 1984).

Analysis of post operation core samples from in-situ combustion projects can be aided by the use of thermal gravimetric analysis (TG) techniques. Identification of specific processes and chemical reactions is possible by use of a combined TG and modeling of isothermal reactions. Samples taken from both original formation material and extracted oil at locations in front of, at, and behind the combustion front in a combustion tube experiment are first investigated using TG. From the thermograph peaks, specific reactions are identified. Weight loss curves at isothermal conditions corresponding to these peaks are analyzed to identify the reaction mechanism. Thermographs from post operation core samples are then used to indicate which combustion processes occurred within the core.

29827 (DOE/METC—85/13, pp 344-362) **Tar sand analysis.** Whitebay, L.E. Feb 1985. NTIS, PC A99/MF A01. File Number DE85001994. (CONF-8406127—).

From WRI/DOE tar sands symposium; Vail, CO, USA (27 Jun 1984).

The realization that steamflooding can alter tar, leaving behind a toluene-insoluble fraction, has led Conoco to modify their approach to tar sand analysis. Conoco has improved the accuracy of the core analyses used to evaluate tar deposits, and gained insight into changes in tar properties during steaming. The work shows that to accurately evaluate a tar sand resource pre- and post-steamflood cores need to be analyzed. Pre-steamflood cores should be analyzed by the Dean-Stark extraction method. Selected samples (one every five feet) should be analyzed to determine the insoluble tar (organic carbon) present in the original tar. Post-steamflood cores should also be analyzed by the Dean-Stark method, however the organic carbon measurement should be made on a foot by foot basis. The combination of the Dean-Stark and the organic carbon data give a complete picture of the tar resource both before and after steamflooding.

29828 (DOE/METC—85/13, pp 516-539) **Mined oil sands bitumen extraction.** Houlihan, R.; Williams, K.; Evans, R.G. (Energy Resources Conservation Board, Calgary, Alberta). Feb 1985. NTIS, PC A99/MF A01. File Number DE85001994. (CONF-8406127—).

From WRI/DOE tar sands symposium; Vail, CO, USA (27 Jun 1984).

The Alberta mineable oil sands resource is extensive and existing commercial operations have demonstrated the technical and economic feasibility of the present technology. However, the technology utilized, particularly the bitumen extraction process, has a number of serious drawbacks with regard to bitumen recovery, energy efficiency, tailings sludge accumulation, and make-up water requirements, particularly when lower grade ores are processed. In accordance with its obligations to ensure orderly, efficient development of energy resources in Alberta consistent with sound environmental protection, the Alberta Energy Resources Conservation Board (ERCB) has expressed its concerns with existing oil sands processing technology and stressed the need for improved technology for processing mined oil sands. The ERCB has continued to prompt investigation of improved technology and to study improvements which develop. The purpose of this work was to present the results of a recently completed study, commissioned by the ERCB, concerned with improved methods of extracting bitumen from mined oil sands.

29829 (DOE/METC—85/13, pp 363-387) **Viscosity of heavy oil and bitumen which contain subsaturation concentrations of carbon dioxide.** Briggs, J.P.; Puttagunta, V.R.; Khiamel, N.B. (Alberta Research Council, Edmonton). Feb 1985. NTIS, PC A99/MF A01. File Number DE85001994. (CONF-8406127—).

From WRI/DOE tar sands symposium; Vail, CO, USA (27 Jun 1984).

Viscosity measurements using a high pressure rotational viscometer were made on oil samples obtained from the Lloydminster and Cold Lake deposits in Canada. The effect of dissolved carbon dioxide, pressure and temperature on the viscosity of these samples was determined. A general equation was developed to correlate the experimental viscosity data with the concentration of carbon dioxide in solution, the temperature and the pressure.

29830 (DOE/METC—85/13, pp 388-405) **Application of carbon-13 and proton NMR to the average structure analysis of Athabasca, Santa Rosa, and Asphalt Ridge tar sand bitumens.** Dalling, D.K.; Bailey, B.K.; Ursenbach, W.O. (Univ. of Utah Research Institute, Salt Lake City). Feb 1985. NTIS, PC A99/MF A01. File Number DE85001994. (CONF-8406127—).

From WRI/DOE tar sands symposium; Vail, CO, USA (27 Jun 1984).

Carbon-13 and proton nuclear magnetic resonance have seen increasing use as tools for analysis of complex hydrocarbon mixtures. Various schemes have been proposed for partition of chemical shift ranges into characteristic regions, and the resulting integration data has been used to calculate various average structure parameters. An optimized set of parameters were chosen which are based on minimum assumptions, and which are suited to the postulation of average structure model compounds. Appropriate computer software was written. The resulting analysis is applied to data obtained for Athabasca, Santa Rosa and Asphalt Ridge tar sand bitumens, and model compounds are developed. Simulated data from the models is then subjected to the same analysis demonstrating the accurate representation which the models make of the original mixtures.

29831 (DOE/METC—85/13, pp 406-419) **Distributions of nitrogen functional groups in Utah tar sand bitumen and produced oils.** Holmes, S.A.; Thompson, L.F. (Western Research Institute, Laramie, WY). Feb 1985. NTIS, PC A99/MF A01. File Number DE85001994. (CONF-8406127—).

From WRI/DOE tar sands symposium; Vail, CO, USA (27 Jun 1984).

Qualitative and quantitative analyses of nitrogen functional groups in solvent-extracted bitumen and produced oils from the Northwest Asphalt Ridge (Utah) tar sand deposit have been completed. Although chemical and physical properties of produced oils (a reverse/forward combustion project and a steamflood project) were different, the distributions of nitrogen functional groups in these oils were similar. In each oil about 65% of the nitrogen content was nonbasic and very weak base, comprised mostly of amide and indole-type nitrogen. About 30% was weak base, comprised mostly of pyridine-type nitrogen. It is suggested that the nitrogen compounds in these oils are different primarily in the amounts of aromatic/aliphatic hydrogen and carbon and not in the distributions of nitrogen functionalities. Significant differences were found in the hydrogen- and carbon-type distributions in these oils. In situ processing conditions used to recover oil may predominately affect the non-nitrogen moieties in the produced oil.

29832 (DOE/METC—85/13, pp 420-438) **Upgrading Utah tar sand bitumen to syncrude.** Bunger, J.W. (Univ. of Utah, Salt Lake City). Feb 1985. NTIS, PC A99/MF A01. File Number DE85001994. (CONF-8406127—).

From WRI/DOE tar sands symposium; Vail, CO, USA (27 Jun 1984).

Upgrading of tar sand bitumen to refinery acceptable crude requires a reduction of molecular weight and a reduction of heteroatoms and metals to acceptable levels. Candidate processes for upgrading include visbreaking, coking, catalytic cracking or hydrocracking, and thermal hydrocracking (hydropyrolysis). Catalytic hydrotreating may be used in combination to remove heteroatoms and metals. Inspection of the molecular structure of Uinta Basin Utah bitumen shows that molecules are of high molecular weight, with a high percentage of molecules containing heteroatoms. However, H/C ratios of 1.6 indicate that the vast majority of carbon present is saturated and therefore is susceptible to cracking. Processes which enhance the rate of cracking while inhibiting dehydrogenation and aromatic condensation reactions are expected to produce high yields of distillable products. Syncrude quality material has been produced from Uinta Basin bitumen by a coking/hydrotreating (C/HT) sequence and a hydropyrolysis/hydrotreating (HP/HT) sequence. C/HT produced syncrude in 64% yields with 13% noncondensible gases and 23 coke/residue as byproducts. Properties of the syncrude are 35 °API, 5 cps μ^{20}, .08% N, .02% S. HP/HT produced syncrude in 74% yields with 22% gas and 4% coke/residue as by-products. Properties of the HP/HT syncrude are 30 °API, 78 cps μ^{20}, .09% N, .03% S. In other results (which do not include a hydrotreatment) Athabasca bitumen was upgraded by hydropyrolysis in 90% yield to 19 °API liquid product. These results compare to 77% yield of 22°API liquid product for coking.

29833 (DOE/METC—85/13, pp 440-472) **Pyrolysis of the bitumen-impregnated sandstone from the P.R. Spring (Utah) deposit in a fluidized bed.** Dorius, J.C.; Hanson, F.V.; Oblad, A.G. (Univ. of Utah, Salt Lake City). Feb 1985. NTIS, PC A99/MF A01. File Number DE85001994. (CONF-8406127—).

From WRI/DOE tar sands symposium; Vail, CO, USA (27 Jun 1984).

The fluidized bed pyrolysis of bitumen-impregnated sandstones to produce hydrocarbon liquids was investigated using the bitumen-impregnated sandstone from the P.R. Spring deposit as feed-sand to the pyrolysis reactor. The P.R. Spring tar sand deposit is the second largest deposit in Utah, and is estimated to contain 4.0 - 4.5 barrels of bitumen in-place. Three distinct tar sand samples were used in this investigation because it was found that the physical and chemical properties of the three bitumens were quite different. The process variables investigated included the pyrolysis reactor temperature and the feed sand retention time in the pyrolysis zone of the reactor. The experimental data were obtained in a continuously fed, fluidized bed reactor operating in a temperature range of 773 - 923 K at solids retention times that ranged from 17-30 minutes. The reactor feed sand through-put was 2.25 kilograms per hour. The particle size of the feed-sand was 300-600 microns. The hydrocarbon liquid product yield (C_5^+ yield) generally decreased with increasing reactor temperature. Concomitant with this decline in the liquid yield, there was an increase in the light gas (C_1-C_4) yield. The liquid product yield increased slightly with decreasing feedsand retention time while the light gas yield decreased. The coke yield was insensitive to process operating variables above 798 K, however, it did appear to be a function of the origin of the feedsand. The quality of the bitumen derived liquids was significantly improved relative to the native bitumen, that is, the viscosity was reduced by four to five orders of magnitude. The API gravity of the liquid product increased from 7.8° API relative to the native bitumen and the pour point decreased from 372 K to 278 K. The volatility of the liquid product increased from 31.9 wt% to 77.2 wt% relative to the native bitumen.

29834 (DOE/METC—85/13, pp 473-506) **Thermal recovery of bitumen from tar sands.** Smart, L.M.; Seader, J.D. (Univ. of Utah, Salt Lake City). Feb 1985. NTIS, PC A99/MF A01. File Number DE85001994. (CONF-8406127—).

From WRI/DOE tar sands symposium; Vail, CO, USA (27 Jun 1984).

A two-staged fluidized-bed reactor for the thermal recovery of bitumen from Utah tar sands was constructed. This reactor is a scaled-up version of an earlier system investigated at the University of Utah, and involves the use of three liquid-potassium heat pipes which thermally couple an upper pyrolysis bed with a lower combustion bed. The reactor has been studied to determine the effect of multiple heat pipes, increased feed rate, and longer duration run times. The process consists essentially of three steps. In the first step, mined and suitably sized tar sand, being fed into the reactor at a constant rate, is pyrolyzed at temperatures of 440°C to above 500°C in an inert atmosphere to volatilize and partially crack most of the contained bitumen. The vaporized products of the pyrolysis section are condensed and coalesced to give a synthetic crude oil. In the second step, coked sand, formed as a by-product in the pyrolysis reactor, is combusted with air at temperatures between 550 and 600°C. In the third step, heat is recovered from the hot spent sand leaving the combustion bed by a fluidized-bed heat exchanger using vertical copper cooling tubes. Three heat pipes are used to transfer 100% of the energy required to maintain the required temperature of pyrolysis in the upper bed. This energy is provided by the lower, combustion bed. Air is used to fluidize the combustion bed and the heat recovery bed. The pyrolysis bed is fluidized with nitrogen. Over 30 runs, with tar sand from the Sunnyside, PR Springs, and Whiterocks deposits, have been made to study controllability of the process, heat requirements, and liquid product yield with respect to process variables such as pyrolysis-bed temperature and average solids-residence times. The highest liquid yield obtained was 71 wt% of the original tar sand bitumen. Typically, coke yield is from 15 to 20 wt%, with gas yield making up the difference.

29835 (DOE/METC—85/13, pp 507-515) **Dravo solvent extraction process for tar sand: update.** Tis, D.J. (Dravo Engineers, Inc., Pittsburgh, PA). Feb 1985. NTIS, PC A99/MF A01. File Number DE85001994. (CONF-8406127—).

From WRI/DOE tar sands symposium; Vail, CO, USA (27 Jun 1984).

The tar sand deposits of Kentucky are generally situated in the south-eastern rim of the Illinois Basin along the southern boundary of the Western Coal Field Region. A recent study reports that Kentucky contains 3.4 billion barrels of oil in tar sand deposits. For comparison, total US petroleum usage in 1983 was 5.5 billion barrels. A commercial extraction process is described that is comprised of the following elements: preparation for extraction; extraction with minimum solvent recirculation, because all of the solvent fed to the extractor is usually recovered by distillation; separation of solvent from the extract, so as to produce an extract with an acceptable residual solvent content; separation of solvent from the spent solids, so as to produce spent solids with an acceptable residual solvent content; and recovery of solvent for re-use.

29836 **Health and safety hazards in synfuel technologies.** Fradkin, L.; Kremer, F.V. (Argonne National Lab., IL). *Energy Progress;* **5**: No. 1, 45-47(Mar 1985).

The development of independent, long-term sources of energy and critical raw material supply has become an economic and political necessity during the past decade as readily available domestic oil reserve is depleting and the world energy supply situation is becoming more unpredictable. Conversion of coal and oil shale to synthetic fuels, however, will be accompanied by a myriad of environmental and health problems. Even through available control technologies will be installed to control residual release, and many work practices will be implemented to reduce hazard exposure, occupational health and safety hazards are still potentially a significant problem associated with a synthetic liquid fuel facility. Potential hazards in oil-shale processing, e.g., fire, explosion, and exposure to toxic and carcinogenic material are discussed.

29837 **Geologic controls of in-situ processing of tar sands, NW Asphalt Ridge, Utah.** Sinks, D.J.; Johnson, L.A.; Fahy, L.J. *American Association of Petroleum Geologists, Bulletin;* **66**: No. 5, 630-631(May 1982). (CONF-8206143—).

From American Association of Petroleum Geologists and Society of Economic Paleontologists and Mineralogists annual convention; Calgary, Canada (27 Jun 1982).

The Laramie-Energy Technology Center completed 3 in situ oil recovery experiments from tar sands at NW Asphalt Ridge, Utah. The 3.28- to 14.75-m thick experimental tar-sand zones are in the Rim Rock sandstone member of the Mesaverde Formation of Cretaceous age. Three experiments were performed at the tract. Two combustion tests using reverse combustion and a combination reverse and forward combustion were completed in a tar-sand bed 3.28 to 3.93 m thick. The third test used steam injection on a 14.75-m thick bed. Tar-sand analyses yielded the following range of data for the 3 tests: extracted porosity, 26.1 to 31.1%; absolute air permeability, 651 to 2175 md; oil saturation, 62 to 75% pv; water saturation, 2.4 to 7.9% pv. Various geological controls can determine the effectiveness of the extraction process. These include the dip of the beds, reservoir thickness, water and oil saturation, porosity, permeability, vertical and horizontal continuity of section, confinement of zone, and potential fractures and faulting in area.

0405 Properties And Composition

REFER ALSO TO CITATION(S) 29616, 29775, 29791, 29818, 29831, 31401

29838 (DOE/METC—85/13, pp 19-33) **Data collection in the oil sands industry: fitting the protocol to the problem.** Wallace, D.; Henry, D.; Krause, W. (Alberta Research Council, Edmonton). Feb 1985. NTIS, PC A99/MF A01. File Number DE85001994. (CONF-8406127—).

From WRI/DOE tar sands symposium; Vail, CO, USA (27 Jun 1984).

Oil sands researchers require many kinds of data ranging from bitumen saturations and particle size distribution of oil sands to measures of physical properties and composition of bitumen. Numerous analytical techniques are available to analysts to provide measurements for many properties of oil sand and bitumen. These techniques are discussed.

29839 (DOE/METC—85/13, pp 58-89) **Geotechnical properties of athabasca oil sands.** Scott, J.D.; Kosar, K.M. (Univ. of Alberta, Edmonton). Feb 1985. NTIS, PC A99/MF A01. File Number DE85001994. (CONF-8406127—).

From WRI/DOE tar sands symposium; Vail, CO, USA (27 Jun 1984).

The geotechnical properties of oil sand and heavy oil cores have been measured and analyzed for a number of years. The strength, compressibility, elastic parameter, permeability and heat transfer properties of the Athabasca oil sand are summarized and discussed. The effects of pressure, heat, and gas solubility on the individual components of oil sand: mineral grains, sand structure, and pore fluids; bitumen, water and gas are reviewed and how these effects control properties of the oil sand mass is discussed. The measured values of the compressibility of the oil sand structure and the pore pressure parameter B during sample saturation and consolidation is significant in interpretation of test results. The influence of sample disturbance, confining pressure, and temperature on the compressibility, shear strength, modulus of elasticity, and Poisson's ratio are illustrated. The influence of temperature on the hydraulic conductivity of oil sand, due to changing viscosity of the bitumen, is the major parameter to be considered when estimating changes in in situ pore pressure magnitude and dissipation. Gas exsolution may also have a major effect on the pore pressure dissipation. Analysis of temperature change effects requires coupling the heat flow analysis with the pore pressure dissipation analysis. Heat transfer properties: thermal conductivity, thermal diffusivity, and specific heat were determined in a triaxial cell where pressure, temperature, and fluid saturation can be controlled.

29840 (NIPER—20, pp 231-240) **Thermodynamic properties of organic nitrogen compounds that occur in shale oil and heavy petroleum.** 28 Feb 1985. NTIS, PC A16/MF A01. File Number DE85000122.

In NIPER annual report, 1984.

Thermodynamic studies are described on alkylpyrroles, alkylpyridines, quinolines, and related substances. New equipment developments for such studies are also described. Condensed-phase heat-capacity measurements of four of the six dimethylpyridines have been completed, and measurements are in progress on the fifth isomer. The results from these studies show that the intrinsic entropy, relative to their corresponding hydrocarbon homomorphs, of the substituted pyridines is significantly different than that of pyridine relative to benzene. The results also show that the corresponding intrinsic entropy for acridine is even more significantly different. New vapor-pressure data were determined for acridine and used in the intrinsic entropy calculations. The new results were obtained with extra care to ensure the sample was adequately outgassed and are as much as 20% lower than results that recently appeared in the literature. Equipment developments were made for all of the property measurements. A new platinum calorimeter was constructed, and progress was made on the construction of two new cryostats for condensed-phase heat-capacity measurements of reactive substances at temperatures from 4 to 523 K. New designs were developed for a combustion calorimetric system which will required one-tenth of the sample presently required but still provide the precision, 0.002%, and accuracy presently attained. New designs were also developed for a torsion-effusion vapor-pressure apparatus for the measurements of high molecular weight substances which cannot be studied with methods suitable for higher pressures. New devices were either purchased and modified or fabricated for spectroscopic cells suitable for study of high temperature vapor, and new sample-handling and cell-filling facilities were developed to ensure that oxygen could be purged and excluded from samples under study.

0406 Direct Uses And By-products

REFER ALSO TO CITATION(S) 29645

0407 Health And Safety

REFER ALSO TO CITATION(S) 29813, 29836

29841 (DOE/ER/60036—T2-Vol.2) **Studies of the Scottish oil shale industry. Final report. Volume 2. Shale workers' pneumoconiosis and skin conditions: epidemiological surveys of surviving ex-shale workers.** Louw, S.J.; Cowie, H.; Seaton, A. (Institute of Occupational Medicine, Edinburgh (UK)). Mar 1985. Contract AC02-82ER60036. 151p. (IOM-TM—85/3). NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE85013324.

This report (in 3 volumes) describes the now defunct Scottish oil shale industry and its effects on the health of its workers. This volume investigates the prevalence of skin disease and pneumoconiosis in Scottish ex-oil shale workers. A cross sectional epidemiological survey has been carried base on a population enrolled in

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the 1950 Scottish Oils Ltd Provident Fund. Investigation of the Fund indicated that it would have included almost all industrial workers employed in the oil shale industry between 1950 and its closure in 1962. It is concluded that workers in the Scottish shale oil industry in its latter years were not at excess risk of skin disease, perhaps because of steps taken within the industry to reduce the known hazards of dermatitis and skin cancer. However, pneumoconiosis was a definite hazard of miners and retort workers and its presence was associated with an impairment of lung function suggestive of fibrosis and possibly emphysema as well. It is suggested that prevention of this hazard might sensibly be based on the strategy used in the coalmining industry and, in the absence of further information on dust and fume exposures of shale workers, standards as applied in coalmining should be appropriate. Radiological surveillance of dust-exposed workers, whether in mines or at retorts or tips, is recommended. 39 refs., 10 figs., 48 tabs.

29842 (DOE/ER/60036—T2-Vol.3) **Studies of the Scottish oil shale industry. Volume 3. Causes of death of Scottish oil shale workers. Final report.** Miller, B.G.; Cowie, H.; Middleton, W.G.; Seaton, A. (Institute of Occupational Medicine, Edinburgh (UK)). May 1985. Contract AC02-82ER60036. 104p. (IOM-TM—85/4). NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE85013325.

The hazards of the Scottish oil shale industry are reported in three volumes. This volume addresses the cause of death for personnel in the oil shale industry. Skin cancer deaths showed a hazard significantly greater than unity. In comparing oil shale workers mortality with that of the population of 2 counties, an increase in death from bronchitis and emphysema was demonstrated. Comparisons of mortality within the study group to determine if any particular jobs in the industry were more hazardous than others showed no significant associations. There appeared to be a slight excess of prostrate cancer among retort workers. In a case-control study, no significant increase in relative hazard of lung cancer was found in association with workers or residents in areas of high shale activity. 21 refs., 4 figs., 27 tabs. (DMC)

29843 (UCRL—15682) **Health and environmental effects document for oil shale: 1984.** Gratt, L.B.; Perry, B.W.; Marine, W.M.; Savitz, D.A.; Chappell, W.R. (IWG Corp., San Diego, CA (USA)). 31 Dec 1984. Contract AC02-82ER60087;AC02-81EV10706;W-7405-ENG-48. 142p. (IWGFR—085-01). NTIS, PC A07/MF A01; GPO Dep. File Number DE85012877.

The third reported effort to analyze the potential human health and environmental risks of a hypothetical one million barrels-per-day industry has been completed as an aid in the formulation and management of a program of environmental research. The methodology for prioritizing key research needs using the risk magnitude and associated uncertainty has been established and demonstrated. The analysis focused on the recommendations of the National Academy of Science's review of the 1982 oil shale risk analysis. Human health risk measures included accident and disease occurrences, premature fatalities, and life-loss expectancies. The sulfate surrogate model was replaced by a fine-particle surrogate resulting in reduced public risks. The largest uncertainties for expected fatalities are in the occupational sector. Occupational injuries and illnesses have been analyzed for the oil shale fuel cycle from extraction to delivery of products for end use. Silicosis from the dust environment is the worker disease of primary concern, followed by other forms of pneumoconiosis, chronic bronchitis, chronic airway obstruction, internal cancer, and skin cancers, respectively. The current nuisance dust threshold limit value of 5 mg/m^3 poses a serious occupational health concern for a future oil shale industry. Research recommendations are presented based on the potential for reducing the estimated uncertainties in the risks. 173 refs., 36 tabs.

0408 Marketing And Economics

REFER ALSO TO CITATION(S) 29735, 31128

29844 (DOE/METC—85/13, pp 3-17) **Challenge of planning for alternative fuels.** Woods, L.M. Feb 1985. NTIS, PC A99/MF A01. File Number DE85001994. (CONF-8406127—).

From WRI/DOE tar sands symposium; Vail, CO, USA (27 Jun 1984).

The problems and challenges involved in the synfuels industry are discussed. Such problems as high interest rates, the government's role in developing new energy supplies, investment decisions, and the forces of supply and demand are discussed.

29845 (DOE/METC—85/13, pp 668-672) **Project financing.** Fletcher, A.L. (Kidder, Peabody and Company, Inc., New York, NY). Feb 1985. NTIS, PC A99/MF A01. File Number DE85001994. (CONF-8406127—).

From WRI/DOE tar sands symposium; Vail, CO, USA (27 Jun 1984).

The financing of tar sands projects is discussed. Project Financing is a term used to describe a financing program which uses the asset itself, and the returns it is expected to produce, to support the financing. It is rare for a project to stand entirely on its own from a credit point of view. The mechanisms which are used to limit the credit support provided by the sponsors are discussed, but the important distinguishing factor is the focus on the asset itself, be it a coal mine, pipeline, ship, or an electric generation station. The most common interest in project finance occurs when the facility to be financed is large enough to require several sponsors. A consortium structure undertaking a project financing allows each company to limit risk by sharing it with other companies and by shifting some of the credit burden to the asset itself. Another reason for turning to a project finance program is that the sponsoring company wants to preserve its ability to borrow under any existing lending agreements it may have and wants to avoid restrictions on its corporate financial flexibility. The third reason for turning to a project financing is that the sponsoring company cannot use tax benefits associated with a facility and wants to employ the economic value of the tax benefits in financing the project.

29846 (DOE/METC—85/13, pp 673-695) **Tax issues affecting tar sands.** Spencer, L.G. Feb 1985. NTIS, PC A99/MF A01. File Number DE85001994. (CONF-8406127—).

From WRI/DOE tar sands symposium; Vail, CO, USA (27 Jun 1984).

There are four major areas of taxation that affect a tar sands project. They are: (1) The Crude Oil Windfall Profit Tax; (2) The Energy Investment Tax Credit: (3) Percentage Depletion Deduction; (4) The Alternative Fuel Production Credit. Each of these areas are discussed, giving an analysis of the law, its application to tar sands, and any problems that have been identified with its application to tar sands, and the current status of any efforts being made to resolve those problems.

0409 Waste Research And Management

29847 (DOE/LC/11003—1805) **Biological treatment of tar sands wastewater. Final report.** Klock, J.W. (Arizona State Univ., Tempe (USA). Coll. of Engineering). Feb 1985. Contract AC20-83LC11003. 69p. NTIS, PC A04/MF A01; GPO Dep. File Number DE85008587.

Waste water from the combustion processing of tar sands was subjected to experimental facultative and anaerobic biological waste treatment systems. The waste was mixed with varying ratios of supplemental sewage nutrient and repeatedly cycled within each of a series of submerged filters flowing horizontally or vertically. The various systems contained from 3 to 5 filter modules utilizing either facultative or anaerobic metabolism or combinations of both. Facultative systems achieved a total of 60 to 70 percent COD reduction at a rate of 10% per day. Anaerobic systems produced similar total reductions at rates of 1.5 to 2.3% per day. 11 figs., 22 tabs.

29848 (DOE/METC—85/13, pp 560-581) **Treatment of tar sand wastewaters by means of air flotation and foam separation.** Boardman, G.D.; Nolan, B.T.; VanLeigh, L.; Bushway, M.H.; McTernan, W.F. (Virginia Polytechnic Institute and State Univ., Blacksburg). Feb 1985. NTIS, PC A99/MF A01. File Number DE85001994. (CONF-8406127—). Contract AS20-81LC10639.

From WRI/DOE tar sands symposium; Vail, CO, USA (27 Jun 1984).

In 1980, the Laramie Energy Technology Center conducted an in situ experiment near Vernal, Utah, to evaluate the feasibility of using steam to mobilize and transport hydrocarbons from tar sand deposits. The experiment demonstrated that steam purging is indeed a viable means of extracting oils, but large quantities of water would be needed to apply the method on a commercial basis. Because most of the tar sand deposits are present in arid areas the large demand for water may best be satisfied through the treatment and recycle of process waters. The work described was initiated in 1981 and was undertaken to assess the effectiveness of air flotation and foam separation operations for the treatment of the Vernal process waters. An attempt to present all of the information generated during the course of the project is not made herein due to the scope of the effort. However, the major points gleaned from the research are presented.

29849 (DOE/METC—85/13, pp 582-597) **Residuals management in physical-chemical treatment of tar sand processing wastewater.** King, P.H.; McTernan, W.F.; Kuo, J.C.J.; Collins, M.R. (Univ. of Arizona, Tucson). Feb 1985. NTIS, PC A99/MF A01. File Number DE85001994. (CONF-8406127—).

From WRI/DOE tar sands symposium; Vail, CO, USA (27 Jun 1984).

Recent research in the treatment of tar sand processing wastewaters has been successful in identifying appropriate physical-chemical processes which can be employed to treat wastewaters generated from in-situ extraction methods to levels compatible with most environmental and industrial standards. Among the various treatment methods explored, particularly satisfactory results were obtained treating a representative steam flooding wastewater with ferric chloride coagulation or single stage polymer-based foam fractionation. In each case, substantial quantities of waste residuals are generated and appropriate dewatering and disposal methods must be developed. This paper discusses recent research aimed at the definition of such dewatering and disposal methods for ferric chloride coagulation sludge and polymer-based foamate. In each case, characterization data are given, and the results of laboratory screening studies of potential dewatering processes, including centrifugation, gravity drainage, and vacuum filtration, are described. An evaluation of the leaching potential of the dewatered residuals was also conducted to determine anticipated release of selected contaminants and, thus, to define the extent to which landfill disposal is consistent with sound environmental management.

29850 (DOE/METC—85/13, pp 598-619) **Cost analysis of water pollution control during in-situ production of bitumen from tar sand.** Owen, T.E.; Humenick, M.J. (Western Research Institute, Laramie, Wyoming). Feb 1985. NTIS, PC A99/MF A01. File Number DE85001994. (CONF-8406127—).

From WRI/DOE tar sands symposium; Vail, CO, USA (27 Jun 1984).

Wastewater recovered by in-situ production of tar sand bitumen using steam drive or combustion processes must be treated prior to recycling in the process, reuse within the production facility, or discharge. Recent laboratory studies have shown biological treatment with activated sludge and reverse osmosis treatment to be potentially effective on combustion wastewater. The hot lime softening process has been used and strong acid ion exchange treatment has been proposed to treat wastewaters from commercial oil sand in-situ steam drive facilities in Canada. The estimated costs associated with the construction and operation of wastewater treatment systems for projected 20,000 barrel-per-day in-situ combustion and steam drive production facilities are presented. The treatment of the steam drive wastewater focuses on recycling the production wastewater to once-through steam generators. The treatment of the combustion wastewater focuses on discharging the effluent. The costs for wastewater treatment range from $0.08 to $2.33 per barrel of bitumen produced in mid-1984 dollars.

29851 (PB—85-157410/XAB) **Water use and reuse opportunities and costs at oil-shale plants.** (Energy and Resource Consultants, Inc., Boulder, CO (USA); Camp Dresser and McKee, Inc., Denver, CO (USA)). 20 Sep 1983. 241p. NTIS, PC A11/MF A01.

See also PB85-128718; Prepared in cooperation with Camp, Dresser and McKee, Inc., Denver, CO.

Converting oil shale into fuels marketable through existing channels requires large-scale mining and processing. The mining and processing operations will consume large amounts of water and will vary from plant to plant. Variations in types of resources and the products produced will lead to a variety of mining and processing schemes each with their own water use patterns. This report describes several of these schemes, as well as their water use and waste water production patterns, water treatment plant designs and costs, and opportunities for internal water reuse and recycling. The project analyzed the ways that water will be used, and may be reused in oil shale plants located in the Upper Colorado River Basin.

0410 Enviromental Aspects

REFER ALSO TO CITATION(S) 29843

29852 (DOE/METC—85/13, pp 541-559) **Tar sand: problems in environmental assessment and management in a developing industry.** Ristau, T.K. (Univ. of Minnesota, Minneapolis). Feb 1985. NTIS, PC A99/MF A01. File Number DE85001994. (CONF-8406127—).

From WRI/DOE tar sands symposium; Vail, CO, USA (27 Jun 1984).

Tar sand and other heavy oil deposits are known to exist throughout the world and in several areas in the US. The leading states in terms of estimated tar sand resource are: Utah (29,530 million barrels); California (323 million barrels); Texas (140 million barrels); New Mexico (57 million barrels); and Kentucky (37 million barrels). Though three of the states with large occurrences are public land states (Utah, California, and New Mexico), recent federal legislative effort directed at increasing the accessibility and exploitation of tar sand resources has been centered on the state of Utah. The single largest known occurrence of tar sand is within the Tar Sand Triangle, in southeastern Utah. A portion of this deposit lies within Glen Canyon National Recreation Area (NRA), and adjacent to Canyonlands National Park (NP). The statutory and regulatory constraints in assessing the environmental effects of tar sand leasing are discussed.

29853 (RAND/R—3040-RC) **Oil shale in the Piceance Basin: an analysis of land use issues.** Rubenson, D.; Pei, R. (RAND Corp., Santa Monica, CA (USA)). Jul 1983. Contract AC01-80PE70271. 87p. NTIS, PC A05/MF A01; GPO Dep. File Number DE85012397.

The purpose of this study was to contribute to a framework for establishing policies to promote efficient use of the nation's oil shale resources. A methodology was developed to explain the effects of federal leasing policies on resource recovery, extraction costs, and development times associated with oil shale surface mines. This report investigates the effects of lease size, industrial development patterns, waste disposal policies, and lease boundaries on the potential of Piceance Basin oil shale resource. This approach should aid in understanding the relationship between federal leasing policies and requirements for developing Piceance Basin oil shale. 16 refs., 46 figs. (DMC)

29854 **Radiological impact of atmospheric emissions from oil shale retorts.** Gogolak, C.V. (Department of Energy, New York, NY). *Environment International;* **11**: No. 1, 57-64(1985).

The radionuclide content of various oil shales, shale oils, and retorting waste products has been studied to determine the extent to which the development of this energy resource may perturb the natural radiation environment. Nearly all of the radioactivity in the raw shale is found in the spent shale after retorting. A primary exposure pathway to the public from this radioactivity will be through the release of particulate matter to the atmosphere during various mining, crushing, and retorting operations. Since the activity of this material is close to that of normal soil, however, the expected radiological impact is small. 26 references, 1 figure, 6 tables.

0420 Regulations

29855 (DOE/METC—85/13, pp 622-644) **Economic impacts of proposed changes to the Federal Tar Sand Leasing program.** Aiken, R.J. Feb 1985. NTIS, PC A99/MF A01. File Number DE85001994. (CONF-8406127—).

From WRI/DOE tar sands symposium; Vail, CO, USA (27 Jun 1984).

On May 24, 1982, the first component of the Federal Tar Sand program, regulations governing the conversion of existing oil and gas leases to combined hydrocarbon leases, were issued. These regulations, together with later regulations governing competitive leasing, set the general framework of the Federal leasing program and allowed the implementation of the program to begin. However, as both industry and government began to plan for the emerging industry, deficiencies in the legal and regulatory framework, which threaten the viability of a mature tar sand industry, became apparent. In an attempt to rectify these deficiencies, the Department of the Interior has been considering possible regulatory changes to the program. These changes were discussed at a public meeting held in Salt Lake City on February 23, 1984. Since that time, the Bureau of Land Management (BLM) has been quantifying and assessing the economic impacts associated with the proposed regulatory changes and its alternatives. The results of that analysis and the assumptions upon which it was based are summarized.

05 NUCLEAR FUELS

REFER ALSO TO CITATION(S) 31710, 31711

0501 Reserves

REFER ALSO TO CITATION(S) 29871, 29872, 29874, 29878, 32390

29856 (DEMO—83/2G) **Detailed investigation of ten small field areas with high radioactivity at the Serres Basin.** Kyrtsou, C. (Democritos Nuclear Research Center, Athens (Greece)). Mar 1983. 11p. (In Greek). NTIS (US Sales Only), PC A02/MF A01. File Number DE85701222.

This report refers to ten field areas in the whole Serres Basin which, following previous radiometric and geochemical prospecting, show some interest from the uranium mineralization point of view. Detailed radiometric measurements are briefly described. In comparison with the background these field areas did not show any district radioactivity. Out of this investigation only eleven field locations with high radioactivity related to the background have been pointed out. These field locations are marked on the map by the characteristic symbols CK_{171} to CK_{181}.

29857 (ERP/MSL—83-39, pp 1-10) **Status report on Kidd Creek Aquitaine project in Nova Scotia.** John, R. (Kidd Creek Mines, (Canada)). Mar 1983. NTIS (US Sales Only), PC A11/MF A01. File Number DE85701198. (CONF-8205300—).

From Canadian Uranium Producers' Metallurgical committee meeting; Bancroft, Ontario, Canada (19 May 1982).

The Kidd Creek uranium deposit was found about 50 km northwest of Halifax, Nova Scotia as a result of geologists acting on the theory that Nova Scotia is geologically a part of Europe. Ore grades run between 0.1% and 0.2%. The site appears suitable for mining. Further development awaits the results of hearings being held throughout the province. Public opposition to the project appears to be strong.

29858 (GSCAN-P—84-1A, pp 53-55) **Radioactive equilibrium studies on four Canadian uranium reference ores.** Grasty, R.L.; Dyck, W. 1984. NTIS (US Sales Only), PC A99/MF A01. File Number DE85780943.

In Current research. Part A.

Four Canadian uranium reference ores were analyzed for their radium-226 and polonium-210 content. Radium-226 was measured both by gamma-ray spectrometry and by a radon emanation technique. Polonium-210 was determined by alpha-spectrometry. A comparison of the recommended uranium values with the measured polonium and radium content showed that within the accuracy of the measurements the four ores are in radioactive equilibrium.

29859 (GSCAN-P—84-1A, pp 129-145) **Selected mineral associations in radioactive and REE occurrences in the Baie-Johan-Beetz area, Quebec. A progress report.** Rimsaite, J. 1984. NTIS (US Sales Only), PC A99/MF A01. File Number DE85780943.

In Current research. Part A.

This paper documents results of rapid chemical, spectrographic, scanning electron microscope, semiquantitative energy dispersive spectrometer, and neutron activation analyses for uranium content of minerals and host rocks for the following associations of primary and secondary minerals: 1. metasediments grading to garnetiferous feldspar pegmatites containing mafic zenoliths; 2. fergusonite-bearing pegmatite and rock-forming feldspars and micas; 3. biotite-hornblende gneiss hosting white radioactive pegmatites containing titanite, allanite and bastnaesite; 4. granite pegmatite containing associations of primary and secondary Pb, Ti, Nb, Th, U and Y minerals; 5. syenite pegmatite containing biotite, uraninite, uranothorite, zircon, apatite, allanite, xenotime, monazite, hydroxylbastnaesite and secondary amorphous phyllosilicates and U, Zr and REE mineral aggregates.

29860 (GSCAN-P—84-1A, pp 229-238) **Gold, tin, uranium and other elements in the Proterozoic Nonacho sediments and adjacent basement rocks near MacInnis Lake, District of Mackenzie.** Maurice, Y.T. 1984. NTIS (US Sales Only), PC A99/MF A01. File Number DE85780943.

In Current research. Part A.

Heavy mineral layers in a pink arkose-quartz-rich conglomerate unit of the Nonacho Group contain notable amounts of U, Th, Sn, Nb, Ta and Au. Enrichment in Th, Sn, Nb, Ta and to a lesser extent in U is related to the detrital dispersal and accumulation of thorite-uranothorite, cassiterite and a suspected but undetected Nb-Ta mineral. These minerals probably originated from sources to the west of the Nonacho basin. in the Fort Smith belt. The clastic minerals are consistently enriched in the heavy mineral layers throughout the arkose-conglomerate unit although Sn appears to be more concentrated towards the base of the sedimentary pile. A decline in the concentrations of the various clastic minerals from south to north is also apparent and reflects increasing distance from source. Hydrothermal enrichment in U and Au is super-imposed upon the detrital pattern in the arkose-conglomerate unit. This activity appears to have been confined to the area adjacent to the southeastern shore of MacInnis Lake and is probably related to hydrothermal activity that led to the formation of nearby U-Cu-Au-Ag veins in basement rocks as well as in Nonacho Group sediments. Uranium is believed to have precipitated in the intergranular spaces of heavy mineral layers in the arkose-conglomerate unit as a result of interaction with Ti compounds and/or in response to reducing conditions associated with the presence of magnetite. Gold is more erratically distributed and is not confined to the heavy mineral layers.

29861 (PER—81, pp 17-20) **U-Pb isotopic evidence pertaining to the age and genesis of uranium mineralisation in Karoo sediments.** Allsopp, H.L.; Welke, H.J.; Armstrong, R.A.; Clough, W.; Evans, I.B. (University of the Witwatersrand, Johannesburg (South Africa). Bernard Price Inst. of Geophysical Research). Jan 1984. NTIS (US Sales Only), PC A04/MF A01. File Number DE85780942. (CONF-8311245—Absts.).

From Symposium for researchers in nuclear geology; Pretoria, South Africa (23 Nov 1983).

Preliminary investigations have been carried out, using the uranium-lead isotopic method, on the uranium mineralisation that occurs within the Karoo sediments. Two occurences were studied, namely the lower Beaufort sediments (Adelaide Subgroup) in the Beaufort West area and the Molteno Formation sediments in the

Ficksburg area. The objectives were to determine the age of the mineralisation and to study the mode of formation of the ores. The pattern of U-Pb apparent ages for all the Karoo samples is $^{207}Pb/^{206}Pb$ age >> $^{207}Pb*^{235}U$ age > $^{206}Pb*^{238}U$ age.

29862 (PER—81, pp 39) **Appraisal of a collimated radiometric face scanner for the in situ determination of gold and uranium in Witwatersrand mines.** Smit, C.J.B. (Pretoria Univ. (South Africa)). Jan 1984. NTIS (US Sales Only), PC A04/MF A01. File Number DE85780942. (CONF-8311245—Absts.).

From Symposium for researchers in nuclear geology; Pretoria, South Africa (23 Nov 1983).

Published in summary form only.

29863 (PER—81, pp 8-9) **Uranium mineralisation in granites of the Bushveld Complex.** Twist, D. (Pretoria Univ. (South Africa)). Jan 1984. NTIS (US Sales Only), PC A04/MF A01. File Number DE85780942. (CONF-8311245—Absts.).

From Symposium for researchers in nuclear geology; Pretoria, South Africa (23 Nov 1983).

Published in summary form only.

29864 (PER—81, pp 9-10) **Quantitative fission-track micro-mapping in the assessment of mineralisation processes in uraniferous alaskites from the Namaqualand Metamorphic Complex.** Robb, L.J. (University of the Witwatersrand, Johannesburg (South Africa). Economic Geology Research Unit). Jan 1984. NTIS (US Sales Only), PC A04/MF A01. File Number DE85780942. (CONF-8311245—Absts.).

From Symposium for researchers in nuclear geology; Pretoria, South Africa (23 Nov 1983).

Published in summary form only.

29865 (PER—81, pp 10-11) **Regional constraints on the possible origin of Namaqualand uraniferous alaskites.** Andreoli, M.; Hart, R.J. (University of the Witwatersrand, Johannesburg (South Africa). Nuclear Physics Research Unit). Jan 1984. NTIS (US Sales Only), PC A04/MF A01. File Number DE85780942. (CONF-8311245—Absts.).

From Symposium for researchers in nuclear geology; Pretoria, South Africa (23 Nov 1983).

Published in summary form only.

29866 (PER—81, pp 12-14) **Uranium and thorium distribution in younger granites of the Cape Granite Suite near Darling.** Schoch, A.E.; Theron, J.C. (University of the Orange Free State, Bloemfontein (South Africa)). Jan 1984. NTIS (US Sales Only), PC A04/MF A01. File Number DE85780942. (CONF-8311245—Absts.).

From Symposium for researchers in nuclear geology; Pretoria, South Africa (23 Nov 1983).

Published in summary form only.

29867 (PER—81, pp 15-17) **Review of current research, problems and future trends with regard to uranium in sedimentary deposits.** Minter, W.E.L. (Cape Town Univ. (South Africa)). Jan 1984. NTIS (US Sales Only), PC A04/MF A01. File Number DE85780942. (CONF-8311245—Absts.).

From Symposium for researchers in nuclear geology; Pretoria, South Africa (23 Nov 1983).

Published in summary form only.

29868 (PER—81, pp 20-21) **Case history of the DR-3 uranium anomaly in the Laingsburg District.** Wadley, R.G. (Johannesburg Consolidated Investment Ltd. (South Africa)). Jan 1984. NTIS (US Sales Only), PC A04/MF A01. File Number DE85780942. (CONF-8311245—Absts.).

From Symposium for researchers in nuclear geology; Pretoria, South Africa (23 Nov 1983).

Published in summary form only.

29869 (PER—81, pp 7-8) **Uranium mineralisation in granites of the Bushveld Complex.** Niemand, N. (Pretoria Univ. (South Africa)). Jan 1984. NTIS (US Sales Only), PC A04/MF A01. File Number DE85780942. (CONF-8311245—Absts.).

From Symposium for researchers in nuclear geology; Pretoria, South Africa (23 Nov 1983).

Published in summary form only.

29870 (PER—81, pp 33-34) **Uraniferous carbon nodules in Witwatersrand conglomerates and Pre-Witwatersrand granite.** Hallbauer, D.K. (Chamber of Mines, Johannesburg (South Africa)). Jan 1984. NTIS (US Sales Only), PC A04/MF A01. File Number DE85780942. (CONF-8311245—Absts.).

From Symposium for researchers in nuclear geology; Pretoria, South Africa (23 Nov 1983).

Published in summary form only.

0502 Exploration

REFER ALSO TO CITATION(S) 29856, 29857, 29863, 29868, 31121, 32390

29871 **(DEMO—82/7G) Report on the geological-geochemical research carried out within the area of geochemical anomaly P_7, Vathyrema, Drama Department.** Stavropoulos, A. (Democritos Nuclear Research Center, Athens (Greece)). Aug 1982. 29p. (In Greek). NTIS (US Sales Only), PC A03/MF A01. File Number DE85701218.

The investigated area covering about 30 km² is situated in the crystalline massive of Rhodope (north of Drama deparment, E. Macedonia) where granitoids constitute its main petrological type. The geological-geochemical and radiometric investigations carried out so far in the area have localized a large number of places with high values of γ-radiation (1.000 - 15.000 c/s), as well as high concentrations of uranium (50-500 ppm). The uranium mineralization within the zone of oxidation is expressed by the uranium mineral autunite, accompanied by intensive hematitization-limonitization and chloritization-kaolinization, and additionally by small spots and veinlets of pyrite and galena. It seems that tectonic control exists on the uranium mineralization, since most of the anomalous concentrations of uranium are sitting along mylonite zones rich in chlorite and kaolin. There have been discerned seven more anomalous part areas which will have to be covered by geochemical stream sediment sampling (phase 3), as well as geological mapping (scale 1:5.000). The results from the research conducted within the concerned anomaly lead us to the conclusion that this area is very promising and possibilities of localization of uranium payable concentrations are very high.

29872 **(DEMO—82/8G) Report on the research so far carried out in the sedimentary basin situated east of Potamoi village, Drama Department.** Stavropoulos, A. (Democritos Nuclear Research Center, Athens (Greece)). Aug 1982. 17p. (In Greek). NTIS (US Sales Only), PC A02/MF A01. File Number DE85701219.

This report refers to the small sedimentary basin of about 40 km² situated east of Potamoi village (north of Drama department) within the crystalline massive of Rhodope. The results of the first phase stream sediment sampling have been very promising. The localization of a great number of radiometric anomalous horizons, mainly of arkosic composition, very rich in hematite-limonite, and with small amounts of carbonaceous material was the result of a first recognizing geological and radiometric research carried out within the area concerned. The geological formation of interest consists of alternating tough beds of different composition (fine-, medium-, course-grained arkoses, conglomerates and siltstone). The strike of these beds is about E-W and their dip about 70 deg northerly. The probable age of this formation is eocenic-oligocenic. A pair of assays from horizons with high γ-radiation have shown concentrations of easily extractable uranium between 100 and 300 ppm. The results from the research so far conducted within the area concerned lead us to the conclusion that this is a very promising area and the possibilities of localization of payable concentrations of uranium in it are very high.

29873 (DEMO—83/6G) **Uranium exploration in Central and Eastern Macedonia and Thrace (Greece). Geology, scintillometry and geochemistry of the map area 2423-2422 Thrace.** Kampanellos, J.; Persianis, D. (Democritos Nuclear Research Center, Athens (Greece)). Apr 1983. 113p. (In Greek). NTIS (US Sales Only), PC A06/MF A01. File Number DE85701223.

In accordance with the agreement between the U.N. Development Programme, the IAEA and the Greek AEC, carborne scintillometer, ground scintillometer and geochemical stream sediment surveys, along with reconnaissance geological mapping, have been carried out in the area of map sheets 2423-2422 (Iasmos, Komotini department, Thrace). The results of these surveys, presented in a series of 15 maps, indicate that six areas totalling 356 km^2 will require further detailed examination in order to test their potential of economic uranium deposits. Three of these areas, Melitena, Medousa and Nimfea, covering in total 143 km^2, should be given first priority and be further tested by detailed stream sediment and bank soil gas sampling, detailed ground scintillometer measurements, grid soil sampling and radon soil gas sampling, as well as by detailed geological mapping.

29874 (DEMO—83/13G) **Report on geological surveys of Vrondou area.** Taousianis, A.; Kyrtsou, C. (Democritos Nuclear Research Center, Athens (Greece)). Sep 1983. 58p. (In Greek). NTIS (US Sales Only), PC A04/MF A01. File Number DE85701221.

The performed research work covered Lalias subarea (A) and Ano-Kato Vrondou and Vathytopos subareas (B). In case A the investigation aimed to the delineation of a quartz vein located in a fault zone with normal high radioactivity. In order to trace the direction of the fault or secondary fault directions with similar radioactivity a grid system (scale 1:500) was set up where the following methods have been applied: scintillation counter radiometry, values of 3rd minute radon (α-radiation) measurements, proton magnetometer measurements and geochemistry with soil sampling from the grid point. Furthermore eleven trenches have been excavated from which rock samples have been taken. The results of the research are the discovery of secondary uranium bearing minerals and the determination of the fault length then was found to be 460 m; the anomalous area, with regard to radioactivity, is 60.000 m^2. Detailed prospecting in the anomalous area and borehole drilling on the anomalous locations are proposed. In case B the performed work consists of stream sediment followup geochemical with radioactivity measurements on the sampling points. 756 geochemical samples have been collected from the Ano-Kato Vrondou subarea (58 km^2) and 627 from the Vathytopos subarea (40 km^2). The results of the geochemical analysis have shown concentrations of easily extractable uranium up to 89 ppm for the first of these subareas and up to 50 ppm for the second one.

29875 (DEMO—83/18G) **Exploration of the possibilities of existence of a considerable uranium mineralization in the Symvolon granodiorite, Kavala Dept.** Stavropoulos, A. (Democritos Nuclear Research Center, Athens (Greece)). Dec 1983. 36p. (In Greek). NTIS (US Sales Only), PC A03/MF A01. File Number DE85701461.

The investigated area (approx. 200 km^2) is confined within the limits of the strongly blastomylonitic Symvolon granodiorite. The effort made at this stage of research aimed first at the interpretation of the geochemical and radiometric anomalies resulted from earlier phases of exploration and second at the determination of the importance degree of the area. A large number of radiometrically anomalous zones, mainly in the NE part of the granodiorite, was localized, striking NW-SE and confined within fractures containing pyrite, in part or totally altered into hematite or limonite. Rock assays and phasmatometry results (γ-radiation) have shown that the high values of gross γ-radiation are due to uranium and also that a satisfying grade of chemical equilibrium exists in the area. Rock samples collected from anomalous zones and analyzed for total uranium gave values between 15 ppm and 400 ppm. The results from the present phase of research have shown that, mainly in the NE part of the area, a tectonic control of the uranium mineralization (along fractures striking NW-SE) is present and also that there may exist considerable uranium concentrations.

29876 (GSCAN-P—84-1A, pp 39-51) **Uranium deposit research, 1983.** Ruzicka, V.; LeCheminant, G.M. 1984. NTIS (US Sales Only), PC A99/MF A01. File Number DE85780943.

In Current research. Part A.

Research on uranium deposits in Canada, conducted as a prerequisite for assessment of the Estimated Additional Resources of uranium, revealed that (a) the uranium-gold association in rudites of the Huronian Supergroup preferably occurs in the carbon layers; (b) chloritized ore at the Panel mine, Elliot Lake, Ontario, occurs locally in tectonically disturbed areas in the vicinity of diabase dykes; (c) mineralization in the Black Sturgeon Lake area, Ontario, formed from solutions in structural and lithological traps; (d) the Cigar Lake deposit, Saskatchewan, has two phases of mineralization: monomineralic and polymetallic; (e) mineralization of the JEB (Canoxy Ltd.) deposit is similar to that at McClean Lake; (f) the uranium-carbon assemblage was identified in the Claude deposit, Carswell Structure; and (g) the Otish Mountains area, Quebec, should be considered as a significant uranium-polymetallic metallogenic province.

29877 (IA—1404, pp 214-216) **Aerial radiometric survey over Israel.** Rapaport, M.S.; Vulcan, U. (Israel Atomic Energy Commission, Tel Aviv); Itamer, A.; Bear, G. (Ministry of Energy and Infrastructure, Jerusalem (Israel). Geological Survey of Israel); Aviv, R. (Everyman's Univ., Tel Aviv (Israel)). Jul 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85780940.

Published in summary form only.

In Research laboratories annual report 1983.

29878 (NP—5900964) **Geological investigation of uranium resources.** (Korean Inst. of Energy and Resources, Seoul (Republic of Korea)). 1983. 152p. (In Korean). NTIS (US Sales Only), PC A08/MF A01. File Number DE85900964.

A geologic investigation of the Ogcheon uraniferous black shale has been carried out at the northeast of Miweon. Geology of the study area consists of following stratigraphic sequences in ascending order pebbly phyllitic rock formation, lower black slate formation, lower sandy phyllite formation, middle black slate formation, middle sandy phyllite formation, upper black slate formation, quartzite formation and upper sandy phyllite formation. These sequences are at the central part of the Ogcheon group rocks. The uraniferous black slate is interbedded in the middle black slate formation, but the uranium content is generally lower than the same horizon of the formerly investigated area during 1977 to 1978. Most of the middle black slate formation in this area was recognized to be barren zone except the Norumok outcrop (62-325 ppM Uranium). A trace element geochemistry was supplemented to study the genesis of the uranium deposits which was surveyed previously. Chemical analysis of the 26 uraniferous black slate samples from the Hanseong adit and Buk-2 adit reveals the following elements. The range of contents is (in ppM): U 6-630, V 323-10777, Mo 70-1200, Ni 95-650, Cu 60-250, Zn <100-6500, Ba 700-9500, Ag <1-18, Ga < 10-15, B < 50, Be 1.2-4, Cd 27-163, Co < 10-50, Cr 60-380, Pb < 40-290, Sn < 10, Sr 30-320, Rb 65-200, Zr 100-400, Th < 5-15. Statistically, correlation coefficient calculations have been used in determining the paragenesis of element in the uraniferous black slate. Autoradiographic studies and observations of graphic slate from Buk-2 adit suggest that uranium was syndepositionally introduced into the graphitic carbonaceous layers. The study also indicates that segregated veinlets in high grade ore zone, composed of quartz, calcite, mica, and sulfide have nothing to do with uranium mobilization in this sample.

29879 (PER—81, pp 24-31) **Review of current research, problems and future trends with regard to geochemical techniques for uranium exploration and recent developments in radon detection.** De Wet, W.J. (Nuclear Development Corp. of South Africa (Pty.) Ltd., Pelindaba, Pretoria). Jan 1984. NTIS (US Sales Only), PC A04/MF A01. File Number DE85780942. (CONF-8311245—Absts.).

From Symposium for researchers in nuclear geology; Pretoria, South Africa (23 Nov 1983).

The review deals with the need for knowledge of uranium geology and exploration techniques. The review mainly focuses on

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radon techniques and closely related aspects. The use of radon as a prospecting tool is primarily based on the fact that it is an inert gas, and threfore, has the ability to migrate through cracks and porous media. The methods used in radon prospecting are based on the detection of α or γ-radon produced during the radioactive decay of Rn and/or Rn decay daughter isotopes. The methods can be described as either active or passive. The active methods involve pumping of soil gas from a narrow hole drilled in the ground and suitably covered, into or through a detector instrument, whereas the passive methods register Rn concentrations in the ground under natural conditions. In uranium exploration the aim is to distinguish areas with enhanced radon concentrations in relation to background levels.

29880 (PER—81, pp 22-23) **Review of the Karoo airborne radiometric survey.** Labuschagne, L.S. (Department of Mineral and Energy Affairs, Pretoria (South Africa). Geological Survey). Jan 1984. NTIS (US Sales Only), PC A04/MF A01. File Number DE85780942. (CONF-8311245—Absts.).

From Symposium for researchers in nuclear geology; Pretoria, South Africa (23 Nov 1983).

A radiometric survey of the Karoo are described. To expedite the survey systematically, the Karoo and parts of Natal were divided into seventeen blocks; ground follow-up of aerial radiometric anomalies was also carried out. It was found that the majority of the uranium occurrences are located in fluvial sandstone of the Beaufort Group, particularly the Adelaide Subgroup. Uranium also occurs in baked mudstone and shale.

29881 (PER—81, pp 34-37) **Review of current research problems and future trends with regard to geophysical methods in uranium exploration.** Andersen, N.J.B. (Nuclear Development Corp. of South Africa (Pty.) Ltd., Pelindaba, Pretoria). Jan 1984. NTIS (US Sales Only), PC A04/MF A01. File Number DE85780942. (CONF-8311245—Absts.).

From Symposium for researchers in nuclear geology; Pretoria, South Africa (23 Nov 1983).

According to the review, radiometric instruments can be used as a mapping tool, providing useful geochemical information in the form of K, U and Th values, thus facilitating the correlation of rock types while mapping. The factors leading to negative results when using spectrometers as mapping tools are also discussed.

29882 (PER—81, pp 5-6) **Uranium in granites.** Schoch, A.E. (University of the Orange Free State, Bloemfontein (South Africa)). Jan 1984. NTIS (US Sales Only), PC A04/MF A01. File Number DE85780942. (CONF-8311245—Absts.).

From Symposium for researchers in nuclear geology; Pretoria, South Africa (23 Nov 1983).

Published in summary form only.

0504 Feed Processing

REFER ALSO TO CITATION(S) 31637

29883 (IA—1404, pp 147-148) **New developments in the technology of uranium recovery from phosphoric acid.** Ketzinel, Z.; Volkman, Y.; Hassid, M.; Melamud, Y.; Elbaz, A.; Pais, M.; Abda, M.; Toor, Y.; Azaria, M.; Gafnir, M. Jul 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85780940.

Published in summary form only.

In Research laboratories annual report 1983.

0505 Enrichment

REFER ALSO TO CITATION(S) 30034, 31679

29884 (GAT-E—279) **Study of mass and momentum transfer and their effect on the direct fluorination of uranium oxide.** Cross, P.E. (Goodyear Atomic Corp., Piketon, OH (USA)). 25 Feb 1983. Contract AC05-76OR00001. 155p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE85012823.

The mechanism for the fluorination of solid U_3O_8 to gaseous UF_6 was found to be a two-step process with solid UO_2F_2 as an intermediate. The highest particle temperatures were found to be associated with the initial reaction step to UO_2F_2; it was recommended that these temperatures be maintained below 1700°F. The chemical equilibrium constant for the fluorination of PuF_4 to PuF_6 was found to be unexpectedly low at typical flame tower temperatures. Although not confirmed, there is an indication in the literature that a similar equilibrium constant is associated with the fluorination of NpF_4 and other transuranic molecules. It was recommended that uranium oxides which are significantly contaminated with transuranics should not be processed through a direct fluorination reactor such as the UF_6 flame tower. Reaction rate equations were developed for the fluorination of U_3O_8, UF_4, PuF_4 and NpF_4. During the course of the development, a significant discrepancy was found in the literature for the activation energy of the fluorination of U_3O_8. Equations were developed for both a high and low limit rate constant for the fluorination of U_3O_8. A variey of momentum, heat and mass transfer equations were developed for both oxide particles and the gas phase within the flame tower. Equations were developed to estimate the physical and transport properties of each gaseous component and the gas mixture as a whole. These properties and the transport equations were used to estimate the reaction time and distance for oxide particles with both the low and high limit reaction rate constant. The procedures used to perform these calculations is limited to constant temperature and an oxide feed comprised of a single particle size. The results indicate that above 1000°F the mass transfer of reactants and products becomes increasingly important to the overall rate of the reaction.

29885 (GAT-T—3334) **Automatic rotary valve actuator.** Cook, W.E. (Goodyear Atomic Corp., Piketon, OH (USA)). 28 Mar 1985. Contract AC05-76OR00001. 51p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85012797.

This report describes the design, construction, and operation of a microcomputer-controlled valve actuator for operating test valves requiring rotary motion of the valve stem. An AIM 65 microcomputer, using a FORTH language program, controls an air motor and air clutch mounted within an oven to accomplish testing at elevated temperatures. The valve actuator closes the test valve until a preset torque is reached and then opens the valve to its initial starting point. The number of cycles and extremes of rotation are tallied and printed as the test progresses. Provisions are made to accept remote signals to stop the test and to indicate to a remote device when the test has been stopped.

29886 (KFK—3793) **Production of value and entropy in separation nozzles. Numerical calculations based on molecular probe measurements.** Ehrfeld, W.; Schelb, W. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Kernverfahrenstechnik; Karlsruhe Univ. (T.H.) (Germany, F.R.). Fakultaet fuer Maschinenbau). Sep 1984. 130p. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number DE85751131.

Thesis.

The effects exerted by separation of the heavy component and the light auxiliary gas, strong variations in the state of the gas in the direction of flow, and strong deviations from local equilibrium upon both isotope separation and pressure losses in separation nozzles are studied. The flow field and the separation of the heavy and light components are investigated. This simulation shows that the separation of the heavy component and the auxiliary gas results in a damping of isotope separation near the curved wall of the nozzle. The strong variations in the state of the gas in the direction of flow result in a large velocity slip between the components in the inner regions of flow. The examination of the local production of entropy shows that the diffusion of the heavy component through the light auxiliary gas may cause up to 30% of the total pressure losses.

29887 **(LA-UR—85-1436) Measurement of uranium enrichment for gaseous uranium at low pressure.** Close, D.A.; Pratt, J.C.; Atwater, H.F.; Malanify, J.J.; Nixon, K.V.; Speir, L.G. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 7p. (CONF-850556—5). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85012697.

From 7. symposium on safeguards and nuclear material management; Liege, Belgium (21 May 1985).

X-ray fluoresence determines the amount of total uranium present in gaseous UF_6 inside cascade header pipes of a uranium centrifuge enrichment facility. A highly collimated source, highly collimated detector, and a very rigid, reproducible geometry are required. Two measurements of the 185.7-keV gamma ray from ^{235}U using two collimators determine the amount of ^{235}U present only in the gas phase. The ratio of the gas-only ^{235}U signal to the total uranium gas-only signal is directly proportional to the enrichment of the process UF_6 gas. This measurement technique is independent of the deposit that forms on a surface in contact with UF_6. This measurement technique is independent of the pressure of the gaseous UF_6. This technique has the required sensitivity to determine whether the process gas is of uranium enrichment $\leqq$ 20% or >20%. 6 refs., 4 figs., 4 tabs.

29888 **(K-Trans—299) Process and device for forming imprints on ceramic tubes.** (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 1985. Contract AC05-84OT21400. Translation of French Patent [Application] No. 78 33446, November 27, 1978. 18p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85013137.

The purpose of the present invention is a process and a device for making imprints on ceramic tubes and these ceramic tubes with imprints. It is known that in uranium enrichment processes by gaseous diffusion, microporous tubes are used to made the diffuser units used for the application of this isotope enrichment process. It is known that these microporous tubes are generally made in two stages. In a first stage, a macroporous ceramic tube called a "support" is made. In a second stage, an internal microporous deposit is made which makes it possible to obtain a tube called a "barrier" finally having the required porosity to apply the gaseous diffusion enrichment process. The present invention involves the first stage of the manufacturing process of the barriers and, more precisely, a step in the manufacturing process of the supports that makes it possible to improve the efficiency of these barriers.

29889 **Method for controlling the viscosity of siloxane oils.** Carey, A.A.; Shor, J.T. (to Dept. of Energy). US Patent Application 6-649,623. 12 Sep 1984. 8p. Contract AC05-84OR21400.

This invention relates to a method of controlling the viscosity of siloxane oils in the presence of lead by adding a small amount of a dione such as p-benzoquinone or 2,3-butanedione.

0506 By-products

REFER ALSO TO CITATION(S) 29993

29890 **(LA-UR—85-1602) Gamma-ray line intensities for depleted uranium.** Moss, C.E. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 5p. (CONF-850507—24). NTIS, PC A02/MF A01; GPO Dep. File Number DE85012674.

From International conference on nuclear data for basic and applied science; Santa Fe, NM, USA (13 May 1985).

Measurements of the gamma-ray line intensities from depleted uranium allowed us to determine which of two conflicting previous experiments was correct. For the 1001-keV line we obtain a branching ratio of 0.834 +- 0.007, in good agreement with one of the previous experiments. A table compares our intensities for several lines with those obtained in previous experiments. 5 refs., 2 figs., 1 tab.

0507 Fuels Production And Properties

REFER ALSO TO CITATION(S) 30040, 31481, 31482, 31483, 31484, 31485, 31486, 31487, 31488, 31489, 31490

29891 **(BARC—1224) Radiochemistry Division annual progress report for 1982.** Bhargava, V.K.; Rao, V.K. (eds.). (Bhabha Atomic Research Centre, Bombay (India). Radiochemistry Div.). 1984. 122p. NTIS (US Sales Only), PC A06/MF A01. File Number DE85900986.

This report gives an account of the work in the areas of nuclear fuels, solution chemistry and solid state chemistry of actinides, radioanalytical chemistry and nuclear chemistry. Studies have been made to optimize chemical parameters for the preparation of UO_2 and ThO_2 microspheres. A preliminary design has been made for the setting up of an engineering scale facility for the production of $(U,Pu)O_2$ gel particles. Synergic extraction studies of various actinides from aqueous solutions have been carried out and nature of species formed established. Double sulphates of U(IV) and Pu(IV) with K and Rb have been prepared, isolated and characterized by chemical, x-ray, infra-red and thermal methods. ^{241}Am has been determined in dissolver solution, using ^{233}U as a reference nuclide by alpha spectrometry. Plutonium in dissolver solution has been determined by IDMS using ^{239}Pu as a spike. Studies have been made on isotope fractionation in thermal ionization mass spectrometry of plutonium. With the availability of the Variable Energy Cyclotron at VEC, Calcutta, the main thrust in the field of nuclear chemistry has been on the studies involving charged particle induced fission. Studies have been carried out on mass distribution and fission fragment angular momentum in the 30 MeV α-particle induced fission of ^{232}Th. 72 refs., 23 figs., 28 tabs.

29892 **Latch assembly.** Frederickson, J.R.; Harper, W.H.; Perez, R. (to Dept. of Energy). US Patent Application 6-641,547. 17 Aug 1984. 13p. Contract AC06-76FF02170.

A latch assembly for releasably securing an article in the form of a canister within a container housing. The assembly includes a cam pivotally mounted on the housing wall and biased into the housing interior. The cam is urged into a disabled position by the canister as it enters the housing and a latch release plate maintains the cam disabled when the canister is properly seated in the housing. Upon displacement of the release plate, the cam snaps into latching engagement against the canister for securing the same within the housing. 2 figs.

0508 Spent Fuels Reprocessing

REFER ALSO TO CITATION(S) 29936, 29937, 30041, 30044, 31616, 31753, 32054, 32055

29893 **(DP-MS—85-57) Multipurpose pan development.** Rodriques, G.C. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1985. Contract AC09-76SR00001. 14p. (CONF-8505139—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE85012326.

From 9. annual actinide separations workshop; Richland, WA, USA (22 May 1985).

Savannah River Plant presently uses separate pans for filtration and roasting PuF_3 precipitates in the Pu metal finishing line. Savannah River Laboratory has developed a multipurpose pan which uses platinum filter media for filtration and roasting. 9 figs., 1 tab.

29894 (IWGFPT—20, pp 74-80) **Irradiated fuel by-product separation research in Canada.** Burston, M. (Nuclear Materials Management Dept., Ontario Hydro, Toronto (Canada)). Dec 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85900589. (CONF-8405285—).

From IAEA improved utilization of water reactor fuel with special emphasis on extended burnups and plutonium recycling meeting; Mol, Belgium (7 May 1984).

Although no decision has been made to reprocess irradiated CANDU fuel, by-product separation research has recently been initiated in Canada because of its potential importance to Canadian research programs in advanced fuel cycles (especially U/Pu cycle development in the near term) and nuclear waste management. In addition, separated by-products could have a significant commercial potential. Demonstrated applications include: heat sources, gamma radiation sources, light sources, new materials for productions of other useful isotopes, etc. For illustrative purposes the calculated market value of by-products currently stored in irradiated CANDU fuel is approximately $210/kgU. Ontario Hydro has initiated a program to study the application of new separation technolgies, such as laser-based techniques and the plasma ion cyclotron resonance separation technique, to either augment and/or supplant the chemical extraction methods. The main goal is to develop new, more economical extraction methods in order to increase the magnitude of the advantages resulting from this approach to reprocessing.

29895 **(KFK—3836) Kinetic investigation of TBP-hydrolysis in the Purex system.** Becker, R.; Stieglitz, L.; Bautz, H. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Heisse Chemie; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Wiederaufarbeitung und Abfallbehandlung). Nov 1984. 56p. (In German). (PWA—76/84). NTIS (US Sales Only), PC A04/MF A01. File Number DE85751142.

The experimental conditions were selected to allow a transfer of the results of the requirements of the Purex-Process. Single phase experiments in aqueous systems were carried out at 50°C, 75°C and 90°C with nitric acid concentrations between 0,5 M/l and 6 M/l and with pure water. The temperature dependence of the hydrolysis rate constants k_1, k_2 and k_3 and the activation energy could be determined from the Arrhenius-plot. Besides in the concentration range investigated linear dependence of the rate constants on the acid concentration was found. The addition of uranium (VI) did not lead to a significant change of the rate constants. Mixed phase experiments were performed at 23.5°C, 50°C and 75°C with nitric acid concentrations of 0,5 M/l and 3 M/l. For the rate constant k_1 the temperature dependence and the activation energy were evaluated. The reaction seems to be a first order reaction with respect to the acid concentration. After the addition of uranium (VI) [approx.=35 g/l (org.)] or zirconium [1g/l (aq.)] the hydrolytic reaction rate was significantly increased. Under these conditions an influence of the nitric acid concentration could not be noticed. The formation of monobutyl phosphoric acid in mixed phase systems was also investigated. During the usual experimental time of approx.=14 days measurable H_2MBP concentrations were only found in the aqueous phase provided that there was a sufficient aqueous HDPB concentration. 18 figures.

29896 **(SKBF-KBS-TR—80-04) Helium retention. Summary of reports and memoranda.** Berggren, G. (Swedish Nuclear Fuel Supply Co., Stockholm. Div. KBS). Feb 1980. 14p. (STUDSVIK-K—1-4-80-12). NTIS (US Sales Only), PC A02/MF A01. File Number DE85701268.

A number of investigations of spent nuclear fuel concerning the formation and retention of helium in the fuel have been performed. The essentials of this work are presented in this review. Retention of helium in minerals is generally very low. Analogies between fuel and minerals have not been conclusively demonstrated.

0509 Transport And Storage

REFER ALSO TO CITATION(S) 29914, 29916, 29918, 29985, 30023, 30043, 31738

29897 **(EUR—9133) Mutual emergency assistance in the event of accident during transport of radioactive materials within the member states of the European Community.** Selling, H.A. (Commission of the European Communities, Luxembourg). 1984. 51p. NTIS (US Sales Only), PC A04/MF A01. File Number DE85701485.

The study consist of a compilation of information on the relevant emergency response plans that are at present in existence in the ten countries of the European Community. Consideration is given to the development of proposals for facilitating co-operation between the emergency services in different countries, particularly with regard to accidents that might occur near national boundaries or in countries in which all the necessary resources might not be available. The particular items of interest covered in this study are: compilation of information on existing organizational emergency response arrangements within each Member State relating to accidents in the transport of radioactive materials by all modes, including road, rail, inland waterways, air and compilation of information on existing arrangements for receiving or providing assistance from or to other Member States. Identification of any avoidable incompatibilities on an international scale. Recommendations for improving the existing arrangements and for encouraging the development of adequate systems of mutual emergency notification, liaison and assistance as required by the circumstances, recommendations should be compatible with the broader framework of emergency response for all types of accidents developed within Member States and envisaged in the IAEA system for mutual emergency assistance.

29898 **(EUR—9195) Stowing of radioactive materials package during land transport. Third phase.** Gilles, P.; Chevalier, G.; Pouard, M.; Jolys, J.C.; Draulans, J.; Lafontaine, I. (Commission of the European Communities, Luxembourg). 1984. 147p. (In French and English). NTIS (US Sales Only), PC A07/MF A01. File Number DE85701486.

Phase 3 of this study is mainly experimental. The study is based on the work performed during 2 former studies: phase 1: definition and analysis of reference accidental conditions, and phase 2: selection of some reference accidents and computation of the deceleration forces. The main goal of the study is to draw up a reference document, giving some guidances for the stowing of packages on conveyances for land transportation. The third phase includes four frontal impact tests. The reference package used is a French IL-37 container weighing about 1.3 t. The first test was performed using a truck, loaded with two IL-37 containers and launched at a speed of 50 km/h against a fixed obstacle. The deceleration curve the behaviour of each package and the behaviour of stowing systems are compared with the theoretical results. Various measurements were made during the test: vehicle impact speed; vehicle deceleration, measured at different points on the frame, package deceleration, displacement of attachment points. The impact was filmed from different angles. The second test was performed in the same impact conditions but with a waggon instead of a truck, and loaded with one container. The front of the waggon was equipped with special shock absorbers to obtain the same deceleration as recorded during the truck impact (first test). In the third test the stowing systems were reinforced by a nylon one in order to obtain information of stowing systems of that type and to increase the energy absorption capacity. In the fourth test in addition to being stowed the package was also chocked. The results obtained have shown that it is possible to maintain a package on a truck platform even during a severe frontal impact.

29899 **(PNL—5122) Status of rod consolidation.** Bailey, W.J. (Pacific Northwest Labs., Richland, WA (USA)). Apr 1985. Contract AC06-76RL01830. 52p. NTIS, PC A04/MF A01; GPO Dep. File Number DE85013030.

Two of the factors that need to be taken into account with rod consolidation are (1) the effects on rods from their removal from the fuel assembly and (2) the effects on rods as a result of the consolidation process. Potential components of both factors are described in the report. Discussed under (1) are scratches on the fuel rod surfaces, rod breakage, crud, extended burnup, and possible cladding embrittlement due to hydrogen injection at BWRs. Discussed under (2) are the increased water temperature (less than 10°C) because of closer packing of the rods, formation of crevices between rods in the close-packed mode, contact with dissimilar metals, and the potential for rapid heating of fuel rods following the loss of water from a spent fuel storage pool. Another factor that plays an important role in rod consolidation is the cost of disposal of the nonfuel-bearing components of the fuel assembly. Also, the dose rate from the components - especially Inconel spacer grids - can affect the handling procedures. Several licensing issues that exist are described. A list of recommendations is provided. 98 refs., 5 figs., 5 tabs.

29900 **(SAND—84-1795) Preliminary cost and risk analysis for transporting spent fuel and high-level wastes to candidate repository sites.** Neuhauser, K.S.; Cashwell, J.W.; Reardon, P.C.; McNair, G.W. (Sandia National Labs., Albuquerque, NM (USA)). Dec 1984. Contract AC04-76DP00789. 55p. (TTC—0506). NTIS, PC A04/MF A01; GPO Dep. File Number DE85013033.

The relative costs and risks of transporting nuclear wastes to nine potential candidate repository sites are discussed. The calculations performed are consistent with previous TTC study, but the analyses have been updated to reflect programmatic assumptions about cask capacities and repository capacity in order to be consistent with the environmental assessments written under the Nuclear Waste Policy Act. Because of the complexity of the issues as well as their regional character, costs and risks should be considered to be relative indicators among the various sites. 19 refs.

29901 **(SAND—85-7161) Analysis of NEPA/CEQ requirements with respect to nuclear materials transportation. Final report.** (International Energy Associates Ltd., Washington, DC (USA)). May 1985. Contract AC04-76DP00789. 90p. NTIS, PC A05/MF A01; GPO Dep. File Number DE85011289.

This report presents the obligations to be met by federal agencies under the guidelines and recommendations implemented by the Council on Environmental Quality (CEQ) in accordance with the National Environmental Policy Act of 1969 (NEPA). Under NEPA, federal agencies must examine environmental issues at all levels of decision making. The report discusses the intent and scope of NEPA and the CEQ, explains the criteria for agency preparation of environmental impact statements, outlines agency practice under CEQ regulations, and examines the applicability of NEPA and CEQ requirements to nuclear materials packaging and transportation. 17 refs., 1 fig.

29902 **Estimation of radiological impact from transportation of uranium mill tailings: Part II: Dispersion and dosimetry.** Yuan, Y.C.; Chee, P.C. (Argonne National Laboratory, Argonne, IL). pp 165-174 of Uranium Mill Tailings Management. Nelson, J.D. Fort Collins, CO; Colorado State Univ. (1982). (CONF-821209—).

From 5. annual symposium on uranium mill tailings management; Ft. Collins, CO, USA (9 Dec 1982).

This paper describes a model to predict the radiation exposure from the dispersion of radon and tailings materials emitted during the remedial action. The potential radiological impacts associated with a hypothetical removal and transportation operation for an existing inactive mill tailings site over a prescribed route are presented to demonstrate the application of the model. Data on radiological parameters from an existing inactive uranium mill tailings site are used to demonstrate the computerized simulation of the model. It is determined that the described integration method can be used to calculate large-area-source and long-line-source dispersion with greater accuracy and significantly reduced computational cost.

0510 Marketing And Economics

REFER ALSO TO CITATION(S) 29959

0520 Waste Management

REFER ALSO TO CITATION(S) 29900, 29902, 30007, 30008, 30016, 30017, 30019, 30020, 30024, 30025, 30028, 30032, 30853, 31471, 31491, 31556, 31560, 31576, 31616, 31641, 31712, 32010, 32382, 32386, 32389, 32393, 32400, 32401, 32402, 32403, 32404, 32406, 32407, 32408, 32409, 32817

29903 **(AERE-G—3161) AERE contracts with DOE on the treatment and disposal of intermediate level wastes. Annual report for 1983/84.** Partridge, B.A. (UKAEA Atomic Energy Research Establishment, Harwell. Chemical Technology Div.). Jun 1984. 87p. NTIS (US Sales Only), PC A05/MF A01. File Number DE85701257.

This document reports work carried out in 1983/84 under 10 contracts between DOE and AERE on the treatment and disposal of intermediate level wastes. Individual summaries are provided for each contract report within the document, under the headings: comparative evaluation of α and $\beta\gamma$ irradiated medium level waste forms; modelling and characterisation of intermediate level waste forms based on polymers; optimization of processing parameters for polymer and bitumen modified cements; ceramic waste forms; radionuclide release during leaching; ion exchange processes; electrical processes for the treatment of medium active liquid wastes; fast reactor fuel element cladding; dissolver residues; flowsheeting/systems study.

29904 **(AERE-G—3176) One third linear scale Joule Ceramic Melter - Progress report April 1983-March 1984.** Robinson, K.S.; Walmsley, D.; Sammons, B.; Hollinrake, A. (UKAEA Atomic Energy Research Establishment, Harwell. Chemical Technology Div.). Jul 1984. 26p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85701254.

This report details the work on Highly Active Liquid Waste Vitrification using the one third linear scale Joule Ceramic Melter carried out in Chemical Technology Division during 1983/84. This work was commissioned by the UK Department of the Environment as part of its radioactive waste management programme.

29905 **(AERE-G—3228) Uranium series disequilibrium measurements at Mol and Whiteshell. Progress report for January-June 1984.** Ivanovich, M.; Wilkins, M.A. (UKAEA Atomic Energy Research Establishment, Harwell. Nuclear Physics Div.). Oct 1984. 4p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85701516.

The current contract is funding two parallel uranium series disequilibrium studies and the aims of and the progress to date of these studies are given in this report. The larger study is concerned with the measurement of uranium series disequilibrium in ground waters derived from sand layers above and below the Boom Clay formation at Mol in Belgium. For 5 observation wells studied to date, the sand layers above the Boom Clay are characterised by low uranium content while below the Boom Clay, the sand layers are characterised by low to moderate uranium content. The second study is concerned with the measurement of the ratio of ^{226}Ra and ^{228}Ra in large groundwater samples which have been scavenged by acrylic fibres impregnated with manganese oxide from the Underground Research Laboratory at Pinawa, Canada.

29906 **(AERE-R—10269) Decontamination of α bearing waste streams using coprecipitation with ferric hydroxide in conjunction with ultrafiltration.** Knibbs, R.H. (UKAEA Atomic Energy Research Establishment, Harwell. Chemical Technology Div.). Oct 1984. 29p. HMSO, London, price Pound 4.00.

The use of ultrafiltration techniques for the treatment of radio-active waste waters is under consideration by the UKAEA. This report considers the decontamination of α bearing waste streams which also contain ferric hydroxide or have it added to enhance the decontamination process. A range of membranes and ultrafiltration equipment have been tested to ascertain flux levels and decontamination factors. Cesub((III)), Thsub((IV)) and Usub((VI)) were used to simulate plutonium and it was found that pH adjustment was necessary to achieve optimum simultaneous rejection of all three species. The paper goes on to analyse membrane fouling mechanisms and develops a model in which the rate of fouling is expressed in terms of a deposition term, dependent on flux and feed concentration modified by a parameter associated with the cross flow configuration, and a re-entrainment term dependent on cross flow velocity and the uncompressed fraction of the fouling layer.

29907 **(AERE-R—11103) Strontium removal from Magnox pond waters by ultrafiltration.** Williams, G.H.; Gutman, R.G. (UKAEA Atomic Energy Research Establishment, Harwell. Chemical Technology Div.). May 1984. 47p. HMSO, London, price Pound 5.00.

Strontium activity has been removed from Magnox pond waters by the in-situ precipitation of titanium hydroxide, and subsequent ultrafiltration to remove the strontium-loaded precipitate from the effluent. The titanium hydroxide produced in this way was sub-micron in particle size and had a high adsorption capacity.

Strontium decontamination factors in excess of 100 have been achieved after the addition of only 2g/m^3 of titanium to the effluent followed by ultrafiltration. Continuous operation of 0.1m^2 plastic, hollow fibre ultrafiltration modules has been demonstrated. After the addition of 4g/m^3 of titanium, effluent was concentrated tenfold by ultrafiltration and then further concentrated by sedimentation, the supernate being recycled to the ultrafiltration process. The overall process volume reduction factor from effluent to titanium hydroxide sludge was 500 with an overall strontium decontamination factor in excess of 100. Least membrane fouling was observed when using hollow fibres of the largest available diameter and when operating in turbulent flow. It was estimated that a membrane flux of 2m/d could, under appropriate conditions, be maintained for periods of almost 20 days. A flowsheet for the operation of a large ultrafiltration plant is discussed.

29008 **(AERE-R—11179) Cold pressed and sintered barium sulphate ceramic waste forms for direct immobilisation of medium level Magnox waste.** Jones, D.V.C.; Preston, R.F.; Briggs, A. (UKAEA Atomic Energy Research Establishment, Harwell. Materials Development Div.). Sep 1984. 24p. HMSO, London, price Pound 4.00.

The cold pressing and sintering behaviour of barium sulphate ceramic waste forms for direct immobilisation of medium level Magnox waste is described. Pellets having a density of 3.7 g cm^{-3} and containing 11.5 v/o open porosity were obtained by first cold pressing at 120 MPa and then sintering at 1300 deg C for 8 h. The leach rate derived from weight losses in Soxhlet tests were 0.5 to 3.5 x 10^{-7} kg m^{-2} sec^{-1}. They are similar to the values obtained for hot pressed barium sulphate floc having only 0.7 to 4.0 v/o open porosity. Unlike single phase ceramic materials where at constant temperature, density is found to be dependent on time, the sintering behaviour of barium sulphate floc was observed to have a short initial period where density was time dependent but then became independent of time (i.e. no further increase of density occurred irrespective of sintering time at a constant temperature).

29009 **(AERE-R—11268) Immobilisation of ^{137}Cs and ^{90}Sr in hot-pressed clinoptilolite.** Briggs, A.; Jones, D.V.C.; Cole, G.B.; Valentine, T.M.; Preston, R.F.; Hawes, R.W.M.; Fones, M.D. (UKAEA Atomic Energy Research Establishment, Harwell. Materials Development Div.). Jul 1984. 38p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85701255.

It is shown that clinoptilolites from Nevada and Mudhills, California, can be vitrified by hot-pressing at 1000 to 1050 deg C for 30 min under 23 MPa pressure in graphite dies, or for 10 min under 3.5 MPa pressure in stainless steel bellows-shaped containers. Activity measurements before and after hot-pressing show that the radionuclides ^{137}Cs and ^{90}Sr are retained almost completely during the process. The hot-pressed material is shown to be extremely resistant to leaching of the nuclides, either in Soxhlet or long-term static leach tests. Gamma-irradiation increases their leachability; that of ^{90}Sr more than that of ^{137}Cs, but even so, the leach rates of both remain very low. X-ray diffraction spectra taken before and after heat-treatment for 10 days at temperatures up to 1000 deg C show no deleterious effects, and hydrothermal treatments at temperatures up to 90 deg C for 100 days, even in the presence of sodium ions in solution, are shown not to cause any changes detectable by X-ray diffraction.

29010 **(AERE-R—11287) Analysis of steady-state hydraulic tests in fractured rock.** Hodgkinson, D.P. (UKAEA Atomic Energy Research Establishment, Harwell. Theoretical Physics Div.). Jul 1984. 36p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85701038.

A model for the analysis of steady-state hydraulic injection tests into single fractures of a rock-mass is presented, and solved analytically. It is used to obtain a probability distribution for the transmissivities of fractures in Cornish granite.

29011 **(AERE-R—11299) Analysis of the AECL/CEC field experiment on the transport of ^{82}Br through a single fracture.** Lever, D.A. (UKAEA Atomic Energy Research Establishment, Harwell. Theoretical Physics Div.). Jul 1984. 23p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85701039.

An analysis of the joint AECL/CEC field experiment performed at the Chalk River test site in Canada in 1983 is presented. A pulse of ^{82}Br tracer was injected into a steady dipole flow field set up in a single fracture between two boreholes 10.6 m apart. A model is presented accounting for dispersal by the dipole flow field and for hydrodynamic dispersion within the fracture. The model is fitted to the experimental data of the breakthrough curve by varying a dispersion length and the water travel time along the line joining the boreholes. In addition, the predicted recovery is compared with an estimate of the actual recovery. Recommendations are made for future experiments.

29012 **(AERE-TP—1061) Review of methodologies used in safety analyses of nuclear waste disposal.** Robinson, P.C. (UKAEA Atomic Energy Research Establishment, Harwell. Theoretical Physics Div.). Jun 1984. 48p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85701258.

The methodologies used in safety analyses of nuclear waste disposal are reviewed. Particular reference is made to the KBS-3 proposals and to the WP-Cave concept. These methodologies are aimed mainly at reducing uncertainties in the predictions of health consequences from nuclear waste repositories, and quantifying the uncertainties that remain. The steps of a safety analysis are described in turn and the currently used techniques are discussed. Recommendations are made as to the use and development of the techniques and the need for new techniques.

29013 **(CONF-850314—69) Monitoring of surface deformation and microseismicity applied to radioactive waste disposal through hydraulic fracturing at Oak Ridge National Laboratory.** Stow, S.H.; Haase, C.S.; Switek, J.; Holzhausen, G.R.; Majer, E. (Oak Ridge National Lab., TN (USA); Applied Geomechanics, Inc., Santa Cruz, CA (USA); Lawrence Berkeley Lab., CA (USA)). 1985. Contract AC05-84OR21400. 6p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85012777.

From Waste management '85; Tucson, AZ, USA (24 Mar 1985).

Low-level liquid nuclear wastes are disposed of at Oak Ridge National Laboratory by the hydrofracture process. Wastes are mixed with cement and other additives to form a slurry that is injected into shale of low permeability at 300 m depth. The slurry spreads radially along bedding plane fractures before setting as a grout. Different methods for monitoring the location and behavior of the fractures have been investigated. Radioactive grout sheets can be located by gamma-ray logging of cased observation wells. Two other methods are based on the fact that the ground surface is deformed by the injection. The first entails surface leveling of a series of benchmarks; uplift up to 2.5 cm occurs. The second method involves use of tiltmeters that are sensitive and measure ground deformation in real time during an injection. Both methods show subsidence during the weeks following an injection. Interpretive models for the tiltmeter data are based on the elastic response of isotropic and anisotropic media to the inflation of a fluid-filled fracture. A fourth monitoring method is based on microseismicity. Geophone arrays were used to characterize the fracture process and to provide initial assessment of the feasibility of using seismic measurements to map the fractures as they form. An evaluation of each method is presented. 8 refs., 6 figs.

29014 **(DOE/DP—0020/1) Evaluation of commercial repository capacity for the disposal of defense high-level waste.** (USDOE Assistant Secretary for Defense Programs, Washington, DC). Jun 1985. 138p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE85013230.

The Nuclear Waste Policy Act of 1982 contained a requirement for the President to evaluate the use of commercial repository capacity for the disposal of defense high-level nuclear waste. The report contains a comparative evaluation of two geologic disposal options for defense high-level waste. The two options are: (1) Dispose of defense high-level waste in a commercial repository; (2) Dispose of defense high-level waste in a defense-only repository. The Act required that the evaluation consider cost efficiency, health and safety, regulation, transportation, public acceptability, and national security. Based on the evaluation, there is a significant cost advantage, approximately $1.5 billion, for disposal of the de-

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fense waste in a commercial repository rather than a separate defense repository. No other factor results in a significant advantage for selecting either option. 14 refs., 14 figs., 21 tabs.

29915 (DOE/NE/44350—1) Project profile of CRYSTL: Phase I and Phase II. (North Carolina Dept. of Natural Resources and Community Development, Raleigh (USA). Div. of Land Resources). Apr 1985. Contract FG02-83NE44350. 76p. NTIS, PC A04/MF A01; GPO Dep. File Number DE85013412.

The US Department of Energy (DOE) plans to locate one high-level nuclear waste repository in the eastern United States by the year 2000. Current plans call for this repository to be located in crystalline rock formations. North Carolina is one of seventeen states with crystalline rock bodies that are under study. DOE is evaluating the geological aspects of the rock bodies as well as the impact a repository will have on the natural and cultural resources of the area. Funds have been granted to North Carolina from DOE to allow the state to review DOE's findings. A portion of these funds have been used to build digital geographic datasets that are being used for this evaluation and review. This report summarizes the data collected and methods used in entering them into the computer.

29916 (DOE/NV/10250—19) Commercial Nuclear Waste Research and Development Program. Quarterly report, January-March 1985. (Westinghouse Electric Corp., Mercury, NV (USA). Waste Technology Services Div.). May 1985. Contract AC08-82NV10250. 28p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85012289.

Revisions requested by DOE/HQ to the plans for shipment of the fuel assemblies from E-MAD to the Idaho National Engineering Laboratory (INEL) and the subsequent shutdown of the facility were completed with all information currently available. At DOE/NV request, the shipping plan was revised to provide an option for loading the General Nuclear Services (GNS) cask with the E-MAD fuel for the Vepco Cask Storage Demonstration Test Number 4 (air-filled intact fuel). A special one-month series of Fuel Temperature Test (FTT) gas sampling operations was completed at the request of Battelle Pacific Northwest Laboratories (PNL). Their assessment of data available to date indicates that the size of the defect has not grown since the fuel rod breach occurred two years ago, and they do not expect fission product contamination inside the FTT. The Months 20 through 24 FTT temperature profiles were completed, and the two year Metal Cask Simulation Test was completed on March 11, 1985. A post-test calibration run (thermal stabilization of the fuel assembly temperatures with no heat input to the system) was performed following completion of the test. The second and third (final) sets of the three month series of gas samples were taken from the helium filled canister containing fuel assembly B41, which is suspected of having one or more defective fuel rods. The canisters containing fuel assemblies D22 and D09 were cut open. Prior to the cutting, gas and full volume filtration samples of the canister atmosphere were taken. Following cutting, integrity of the fuel was checked and documented by visual examination, photodocumentation, videotaping and by taking surface contamination swipes from designated fuel rod surfaces.

29917 (DOE/OR/21400—T126) Performance Assessment National Review Group. Lieberman, J.A.; Davis, S.N.; Harleman, D.R.F.; Keeney, R.L.; Kocher, D.C.; Langmuir, D.; Lyon, R.B.; Owens, W.W.; Pigford, T.H.; Lee, W.W.L. (Weston (Roy F.), Inc., Rockville, MD (USA)). Feb 1985. Contract AC05-84OR21400;AC01-83NE44301. 114p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE85011807.

Performance assessment involves predicting the potential radiological impact of a nuclear waste disposal system, taking into account all of the natural and engineered components of the system. It includes the analysis and evaluation of predicted system and component performance to determine compliance with regulatory performance criteria. In the context of the nuclear waste management program, performance assessment has five major purposes: to assist in the evaluation and selection of repository sites; to guide the research, development, and testing programs; to assist in the evaluation of repository designs; to assist in the evaluation of the design and performance of engineered barriers; and to show regulatory compliance and support repository licensing. Current performance assessment methodologies are still in the developmental stage. Only the simplest of bounding calculations have produced quantitative predictions of radionuclide releases. The methodologies require considerable extension and validation before they can provide answers suitable for project decisions and licensing. 135 refs., 9 figs., 1 tab.

29918 (DOE/RW—0022) Need for and feasibility of monitored retrievable storage: a preliminary analysis. (USDOE Office of Civilian Radioactive Waste Management, Washington, DC). Apr 1985. 39p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85013153.

The Nuclear Waste Policy Act of 1982 directed the Department of Energy (DOE) to complete a study of the need for, and the fesibility of, monitored retrievable storage (MRS). This study will form part of the basis for the Secretary's recommendation to Congress with regard to an MRS facility. This paper is the DOE's initial analysis of this important topic. 8 figs., 2 tabs.

29919 (DOE/RW—0023) Screening and identification of sites for a proposed Monitored Retrievable Storage Facility. (USDOE Office of Civilian Radioactive Waste Management, Washington, DC). Apr 1985. 70p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85013154.

The Director, Office of Civilian Radioactive Waste Management (OCRWM), Department of Energy (DOE), has identified the Clinch River Breeder Reactor site, the DOE Oak Ridge Reservation and the Tennessee Valley Authority (TVA) Hartsville Nuclear Plant site as preferred and alternative sites, respectively, for development of site-specific designs as part of the proposal for construction of an integrated Monitored Retrievable Storage (MRS) Facility. The proposal, developed pursuant to Section 141 (b) of the Nuclear Waste Policy Act of 1982, will be submitted to Congress in January 1986. The Director expects to propose to Congress that an MRS be constructed at the perferred site. His judgment could change based on information to be developed between now and January 1986. The decision to construct an MRS facility and final site selection are reserved by Congress for itself. The Director's judgment is based on the results of a rigorous site screening and evaluation process described in this report. The three sites were selected from among eleven sites evaluated in detail. The Clinch River Breeder Reactor site, owned by the Tennessee Valley Authority, was identified as the preferred site. It has several particularly desirable features including: (1) federal ownership and control by the Department of Energy; (2) particularly good transportation access (five miles to the nearest interstate highway and direct rail access); (3) site characteristics and current data base judged by the NRC in 1983 as sufficient for granting a limited work authorization for the now cancelled breeder reactor; and (4) a technical community in the vicinity of site which can provide experienced nuclear facility support functions. 6 figs., 2 tabs.

29920 (DP-MS—84-140) I-129 analysis in radioactive waste. Ryan, J.P.; Winn, W.G. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 28 Apr 1985. Contract AC09-76SR00001. 15p. (CONF-850417—20). NTIS, PC A02/MF A01; GPO Dep. File Number DE85012323.

From 189. national meeting of the American Chemical Society; Miami, FL, USA (28 Apr 1985).

A neutron activation method is described for the analysis of I-129 in defense waste salt solutions. 10 refs., 2 figs., 3 tabs.

29921 (DP-MS—84-141) Electrically fired incineration of combustible radioactive waste. Charlesworth, D.; Hill, M. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.; Shirco, Inc., Dallas, TX (USA)). 1985. Contract AC09-76SR00001. 9p. (CONF-850744—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE85010067.

From National conference on environmental engineering; Boston, MA, USA (1 Jul 1985).

Du Pont Company and Shirco, Inc. are developing a process to incinerate plutonium-contaminated combustible waste in an electrically fired incineration system. Preliminary development was

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completed at Shirco, Inc. prior to installing an incineration system at the Savannah River Laboratory (SRL), which is operated by Du Pont for the US Department of Energy (DOE). The waste consists of disposable protective clothing, cleaning materials, used filter elements, and miscellaneous materials exposed to plutonium contamination. Incinerator performance testing, using physically representative nonradioactive materials, was completed in March 1983 at Shirco's Pilot Test Facility in Dallas, TX. Based on the test results, equipment sizing and mechanical begin of a full-scale process were completed by June 1983. The full-scale unit is being installed at SRL to confirm the initial performance testing and is scheduled to begin in June 1985. Remote operation and maintenance of the system is required, since the system will eventually be installed in an isolated process cell. Initial operation of the process will use nonradioactive simulated waste. 2 figs., 2 tabs.

29922 (DP-MS—85-9) **Slag cement - low-level waste forms at the Savannah River Plant.** Malek, R.I.A.; Roy, D.M.; Barnes, M.W.; Langton, C.A. (Pennsylvania State Univ., University Park (USA). Materials Research Lab.; Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1985. Contract AC09-76SR00001. 41p. (CONF-850536—3). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85012328.

From American Ceramic Society annual meeting; Cincinnati, OH, USA (5 May 1985).

A cement based waste form is being designed for disposal of Savannah River Plant low-level radioactive waste salt. The disposal process includes emplacing the saltstone in engineered trenches. The waste form (matrix) must exhibit reasonable physical/mechanical properties with minimal leaching of the contained waste salts (1). As part of a program carried out at PSU/MRL to optimize properties of the waste form (2), formulations containing low-calcium fly ash and granulated blast furnace slag with and without portland cement have been tested and the data compared with those of other mixes containing either low- or high-calcium fly ash and no slag. The results of physical/mechanical testing, leach tests, chemical characterization, and adiabatic heat of hydration are presented. Included is a review of the alkali-activated slag hydration process. 12 refs., 21 figs., 10 tabs.

29923 (DP-MS—85-11) **Use of Co-60 gamma irradiation to simulate decomposition of tetraphenylborate precipitates from high-level radioactive waste.** Gupta, A.K.; Hanrahan, R.J.; Walker, D.D.; Ebra, M.A. (Florida Univ., Gainesville (USA). Dept. of Chemistry; Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1985. Contract AC09-76SR00001. 24p. (CONF-850417—21). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85012324.

From 189. national meeting of the American Chemical Society; Miami, FL, USA (28 Apr 1985).

Savannah River Plant nuclear waste requires the decontamination of approximately 100 million gallons of salt solution. The radioactive Cs-137 will be removed by precipitating it as a tetraphenylborate (TPB) salt. This radioactive precipitate will be stored in large, underground steel tanks for approximately two years until it is consigned to the Defense Waste Processing Facility (DWPF) for immobilization in glass. During the processing and storage, the tetraphenylborate precipitate will be subjected to intense beta and gamma irradiation which will cause partial decomposition leading to the production of many organic compounds. The purpose of this project was to qualitatively and quantitatively identify the organic products formed from the radiolysis of soluble and insoluble tetraphenylborate salts.

29924 (EGG-PBS—6851) **Technical evaluation of the NUS Process Services Corporation Radwaste Solidification System topical report.** Henscheid, J.W.; Young, T.E. (EG and G Idaho, Inc., Idaho Falls (USA)). 18 Apr 1985. Contract AC07-76ID01570. 11p. NTIS, PC A02/MF A01 - GPO. File Number TI85011678.

This report summarizes EG & G Idaho's review of the NUS Process Services Corporation topical report on a Radwaste Solidification System. The review evaluated compliance with pertinent codes, standards and regulations. The initial review was discussed with NUS, and all outstanding issues resolved before this final evaluation was made.

29925 (ERP/MSL—83-39, pp 1-31) **Evaluation of tailings stabilization methods.** Ritcey, G.M.; Skeaff, J.M. (Canada Centre for Mineral and Energy Technology, Ottawa, Ontario). Mar 1983. NTIS (US Sales Only), PC A11/MF A01. File Number DE85701198. (CONF-8205300—).

From Canadian Uranium Producers' Metallurgical committee meeting; Bancroft, Ontario, Canada (19 May 1982).

Four commercial waste solidification processes based on inorganic and asphaltic binders were applied to uranium (and leach) mill tailings. The solidified tailings were evaluated by measuring their physical and chemical properties immediately after solidification and as a function of time. The method based on an asphaltic binder was superior but was more expensive by an order of magnitude than a lime based method. Hence the lime based method was considered to be the best compromise, yielding relatively good properties at reasonable costs.

29926 (EUR—8669) **Directory of computer programs for assessment of radioactive waste disposal in geological formations.** Broyd, T.W.; Dean, R.B.; Hobbs, G.D.; Knowles, N.C.; Putney, J.M.; Wrigley, J. (Commission of the European Communities, Luxembourg). 1984. 536p. NTIS (US Sales Only), PC A23/MF A01. File Number DE85701517.

This Directory describes computer programs suitable for the assessment of radioactive waste disposal facilities in geological formations. The programs, which are mainly applicable to the post closure analysis of the repository, address combinations of the following topics: nuclide inventory, corrosion, leaching, geochemistry, stress analysis, heat transfer, groundwater flow and radionuclide transport. Biosphere modelling, surface water flow and risk analysis are not covered. A total of 248 programs are identified, of which 50 are reviewed in detail, 134 in summary and 64 in tabular fashion. The directory has been compiled using a combination of literature searches, telephone and postal correspondence and meetings with recognised experts in the respective areas of work covered. It differs from previous reviews of computer programs for similar topics areas in two main respects. Firstly, the method of obtaining information has resulted in program descriptions of considerable breadth and detail. Secondly, the Directory has concentrated wherever possible on European codes, whereas most previous work of this nature has looked solely at programs developed in North America. The reviews are presented in good faith, but it has not been possible to run any of the programs on a computer, and so truly objective comparisons may not be made. Finally, although the Directory is specific to the post-closure assessment of a repository site, some of the programs described could also be used in other areas of repository analysis (e.g., repository design).

29927 (EUR—9071) **Feasibility study for the final disposal in the Konrad mine based on experiments for radioactive waste isolation and handling.** (Commission of the European Communities, Luxembourg). 1984. 192p. (In German). NTIS (US Sales Only), PC A09/MF A01. File Number DE85701264.

The studies contained in this report prove both the suitability of the disused iron-ore mine Konrad for the final disposal of low level radioactive wastes and decommissioning waste from nuclear power stations and the safety of the disposal operations. Petrographical, geochemical, hydrogeological, hydrochemical, rock mechanical, seismic and radiological investigations are reported.

29928 (EUR—9106) **Long-term storage of ^{85}Kr in amorphous zeolite 5A.** Penzhorn, R.D.; Noppel, H.E.; Dorea, A.; Guenther, K.; Leitzig, H.; Schuster, P. (Commission of the European Communities, Luxembourg). 1984. 73p. NTIS (US Sales Only), PC A04/MF A01. File Number DE85701518.

Ar, Kr and Xe can be immobilized in type A zeolites as well as in mordenite and chabazite, when the original crystal structure is hydrothermally vitrified in the presence of the densified gas. Zeolites containing a high percentage of earth alcali metals yield encapsulates that are thermally very stable. Gas fixation conditions are essentially independent of the form of aggregation of the matrix. Noble gas encapsulates were characterized by their specific surface area as well as by microprobe analysis, X-ray analysis and electron diffraction. The results indicate that Kr is immobilized in units smaller than the size of a zeolite crystal. The thermal conductivity of zeolites was determined experimentally in various fluid media. With the data obtained the heat transport through a final storage vessel cooled by natural air convection was calculated. The estimated temperature profiles correlate well with those obtained in experiments simulating a storage containment. To verify the process, active samples having specific activities up to 30 mCi/g have been prepared. Leaching results demonstrate the chemical stability of the Kr/5A encapsulates. A semi-pilot facility based on the one-way autoclave concept has been constructed and demonstrated in operation.

29929 (GAT-S—33) **Biodegradation of uranium-contaminated waste oil.** Hary, L.F. (Goodyear Atomic Corp., Piketon, OH (USA)). 14 Mar 1983. Contract AC05-76OR00001. 39p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85012804.

The Portsmouth Gaseous Diffusion Plant routinely generates quantities of uranium-contaminated waste oil. The current generation rate of waste oil is approximately 2000 gallons per year. The waste is presently biodegraded by landfarming on open field soil plots. However, due to the environmental concerns associated with this treatment process, studies were conducted to determine the optimum biodegradation conditions required for the destruction of this waste. Tests using respirometric flasks were conducted to determine the biodegradation rate for various types of Portsmouth waste oil. These tests were performed at three different loading rates, and on unfertilized and fertilized soil. Additional studies were conducted to evaluate the effectiveness of open field landfarming versus treatment at a greenhouse-like enclosure for the purpose of maintaining soil temperatures above ambient conditions. The respirometric tests concluded that the optimum waste oil loading rate is 10% weight of oil-carbon/weight of soil (30,600 gallons of uranium-contaminated waste oil/acre) on soils with adjusted carbon:nitrogen and carbon:phosphorus ratios of 60:1 and 800:1, respectively. Also, calculational results indicated that greenhouse technology does not provide a significant increase in biodegradation efficiency. Based on these study results, a 6300 ft.^{2} abandoned anaerobic digester sludge drying bed is being modified into a permanent waste oil biodegradation facility. The advantage of using this area is that uranium contamination will be contained by the bed's existing leachate collection system. This modified facility will be capable of handling approximately 4500 gallons of waste oil per year; accordingly current waste generation quantities will be satisfactorily treated. 15 refs., 14 figs., 4 tabs.

29930 (HEDL—7540) **Technical test description of activities to determine the potential for spent fuel oxidation in a tuff repository.** Einziger, R.E. (Hanford Engineering Development Lab., Richland, WA (USA)). Jun 1985. Contract AC06-76FF02170. 57p. NTIS, PC A04/MF A01; GPO Dep. File Number DE85013265.

The potential change in the oxidation state of spent fuel during its residence in a repository must be known to evaluate its radionuclide retention capabilities. Once the container breaches, the spent fuel in a repository sited above the water table will be exposed to a moist air atmosphere at low temperatures. Thermodynamically, there is no reason why the fuel should not oxidize to a higher oxidation state under these conditions, given enough time. Depending on the rate of oxidation, higher oxides with potentially higher leach rates may eventually form or the cladding may even split open. If either of these oxidation effects occurs, the ability of spent fuel to retard radionuclide migration will be reduced. A technical test description is presented to study spent fuel oxidation at low temperatures characteristic of the post-container breach period and at high temperatures in a moist inert atmosphere characteristic of a sealed container with waterlogged fuel, early in the repository life. The approach taken will be to perform tests and evaluations to gain understanding of the operative oxidation mechanisms, to obtain oxidation rate data, and to make projections of potential long-term fuel oxidation states. Time and temperature dependence of existing models will be evaluated, and the dependence of the model projections on fuel variables will be determined. 27 refs., 7 figs., 4 tabs.

29931 (IA—1404, pp 156) **Purification of low-level radioactive effluents by membrane-based processes.** Boger, Z.; Cikurel, H.; Trigerman, S.; Hodara, I. Jul 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85780940.

Published in summary form only.

In Research laboratories annual report 1983.

29932 (IAEA-TECDOC—319) **Effects of heat from high-level waste on performance of deep geological repository components. Report of a technical committee meeting on effects of heat from radioactive waste in deep geological repositories organized by the IAEA and held in Stockholm, 28 August-2 September 1983.** (International Atomic Energy Agency, Vienna (Austria)). Nov 1984. 81p. NTIS (US Sales Only), PC A05/MF A01. File Number DE85701046.

This report discusses the effects of heat on the deep geological repository systems and its different components. The report is focussed specifically on effects due to thermal energy release solely from high-level waste or spent fuel. It reviews the experimental data and theoretical models of the effects of heat both on the behaviour of engineered and natural barriers. A summary of the current status of research and repository development including underground test facilities is presented.

29933 (INFO—0070) **Qualitative evaluation of long-term processes governing the behaviour of uranium mill tailings placed in deep lakes.** (Beak Consultants Ltd., Toronto, Ontario (Canada); Atomic Energy Control Board, Ottawa, Ontario (Canada)). Mar 1982. 42p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85701225.

French version included. Study conducted for the Atomic Energy Control Board.

The emplacement of uranium mill tailings in deep lakes may provide an acceptable method of tailings disposal at certain sites in Canada. Disposal in a depositional environment typical of deep lakes appears to offer greater prospects for long-term stability than present methods of land-based management. From the regulatory point of view, it is necessary to know which factors should be taken into account in assessing the acceptability of such an approach. This report examines the environmental variables governing the behaviour of radionuclides and trace elements in the groundwater systems, lake water, and finally in the biosphere over the short and long term. Physical, chemical and biological factors are each considered. Conclusions are presented in terms of points for and against disposal in deep lakes. This report summarizes the data and conclusions presented in an annex volume.

29934 (INFO—0070-App.) **Qualitative evaluation of long-term processes governing the behaviour of uranium mill tailings placed in deep lakes. Annexes.** McKee, P.; Snodgrass, W.; Lush, D.L.; Ross, P. (Atomic Energy Control Board, Ottawa, Ontario (Canada)). Mar 1982. 305p. NTIS (US Sales Only), PC A14/MF A01. File Number DE85701226.

The emplacement of uranium mill tailings in deep lakes may provide an acceptable method of tailings disposal at certain sites in Canada. Disposal in a depositional environment typical of deep lakes appears to offer greater prospects for long-term stability than present methods of land-based management. From the regulatory point of view, it is necessary to know which factors should be taken into account in assessing the acceptability of such an approach. This report examines the environmental variables governing the behaviour of radionuclides and trace elements in the groundwater systems, lake water, and finally in the biosphere over the short and long-term. Physical, chemical and biological factors are each considered. Conclusions are presented in terms of points for and against disposal in deep lakes.

29935 (INS-R—312) **Requirements of the London Convention for dumping radioactive waste at sea.** Sutton, H.C. (Department of Scientific and Industrial Research, Lower Hutt (New Zealand). Inst. of Nuclear Sciences). Oct 1982. 73p. NTIS (US Sales Only), PC A04/MF A01. File Number DE85701520.

This report outlines the requirements of the London Convention for dumping radioactive waste at sea and considers their scientific basis more fully. It is intended primarily as an appraisal and aid to understanding of the two documents IAEA 210 and IAEA 211, published by the International Atomic Energy Agency, and relating to the oceanographic and radiobiological basis of their definitions of high level waste and recommendations relating to its dumping at sea, which were required for London Convention purposes. The adequacy and conservation in these recommendations are considered, and the report also compares the predictions of the model on which the recommendations are based with some limited but relevant observations on radiation doses resulting from natural causes (radium in the sea), and from fallout from nuclear bomb tests. It is concluded that if dumping is carried out within the limits and according to the recommendations required by the IAEA, then it is extremely unlikely that this could lead to significant human hazard, either now or in the future. Some of the reasons for this conclusion are summarised in the final chapter.

29936 (JAERI-M—84-043) Recovery of neptunium. Literature survey. Morita, Yasuji; Kubota, Masumitsu. (Japan Atomic Energy Research Inst., Tokyo). Mar 1984. 32p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. File Number DE85701029.

Contains 62 refs. .

The literature survey was carried out on the behavior and the recovery of Neptunium-237 which had become one of the most significant isotopes from a viewpoint of the safety management of the high-level waste. The present report consists of three parts; in the first part neptunium behavior in Purex process is described, in the second the methods to recover Np in Purex process by a small modification and in the third neptunium recovery from the high-level waste. It became clear that in Purex process the oxidation of Np catalyzed by nitrite played an important role at the co-extraction stage. At the following stages neptunium behavior is influenced by a characteristic of plutonium reductant, acidity in aqueous phase and the uranium concentration in organic phase. Neptunium recovery from the high-level waste needs an adjustment of neptunium valence, generally a reduction to Np (IV). It seems a key point to control a valence for the separation and the recovery. Studies on neptunium recovery are expected taking into account of controlling neptunium valence with a salt-free process and improving a recovery rather than a purity of Np. This report will contribute to the development of partitioning process including neptunium recovery.

29937 (Juel—1953) Distillation as a means of separating krypton from the off-gas of a reprocessing plant for graphite-coated HTR fuel elements. Juergens, B. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Chemische Technologie der Nuklearen Entsorgung). Oct 1984. 145p. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number DE85751651.

The AKUT-II facility is described, which is designed for an off-gas throughput of 10 Nm³/h. The low-pressure section is for primary purification in several steps, whereas in the high-pressure CO_2 section (70 bar, 20°C) the separation of Kr-85 by means of distillation is achieved. The parameters for the design of the rectifying columns have been determined experimentally.

29938 (KBS-TR—121) KBS Technical report 1-120 (1977-1978). Summaries. (Kaernbraenslesaekerhet, Stockholm (Sweden)). May 1979. 318p. NTIS (US Sales Only), PC A14/MF A01. File Number DE85701265.

The Swedish nuclear utilities started early in 1977 the KBS (nuclear fuel safety) project to study the high level waste problem and report on how and where a safe final storage could be arranged in Sweden. The docummentation produced by the project during 1977 and 1978 has been collected in a series of technical reports numbered from 1 to 120. The English summaries of the technical reports have been collected in this separate volume, No. 121.

29939 (KFK—3825) Optimization of activity loading of low and medium level waste packages. Hauser, W. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Nukleare Entsorgungstechnik). Jan 1985. 53p. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE85751646.

The described BASIC program packet PROMAX, consisting of 15 independent single programs, each one applicable to one type of waste package, calculates the maximum specific activity (output) of the final waste form for the specified dose rate limits with the nuclide names and activity portions (waste specific composition of activity) used as the input. The calculations are based on the packages for low and medium level wastes used at the Karlsruhe Nuclear Research Center, e.g., non-shielded 200/400 l drums, sheet steel containers, single concrete shieldings for 200/400 l drums, concrete containers and a cast steel container. Based on the calculations the most appropriate package can be selected for a waste to be conditioned and, if applicable, a specification be given for concentrating or mixing various waste types. This report describes the method of calculation and demonstrates the application of the program packet on the example of conditioning various LLW/MLW waste solutions. In addition, the containers described are discussed with a view to their shielding properties.

29940 (NPC(W)R—764) Fully engineered shallow trench design concepts for disposal of low and intermediate level radioactive waste. Interim report. Locke, J. (National Nuclear Corp. Ltd., Whetstone (UK)). Sep 1984. 33p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85701266.

In this report, the results of the reviews of design concepts, waste arisings and release mechanisms are described. The basic principles of radiological protection and the proposed strategy for land disposal in the UK are outlined. The essential features of engineered trenches are described with some discussion of the likely material choices and their influence on nuclide release. The radiological protection criteria adopted in this study is that the overall risk of serious health effects arising from any release of radioactivity from a shallow engineered trench should always be less than 10^{-6} per annum, which corresponds to a received dose of 0.1 mSv/yr. This approach to radiological protection takes account of the two components of risk of health detriment to future generations; namely the probability that a release of radionuclides will occur and the probability that the subsequent radiation doses will give rise to deleterious effects. A compilation is presented of the waste streams and expected volumes and activities that may be designated for LAND 2 disposal and an initial estimate of the associated nuclide inventory is given.

29941 (NUREG/CP—0062, pp 29-30) **Thermodynamic problems in speciation modeling.** Barnes, H.L. (Pennsylvania State Univ., University Park). Apr 1985. NTIS, PC A06/MF A01 - GPO. File Number TI85009817. (CONF-8410234—Summs.; ORNL/TM—9585).

From Application of geochemical models to high-level nuclear waste repository assessment; Oak Ridge, TN, USA (2 Oct 1984).

The principal goal of geochemical modeling is to provide a rigorous evaluation of mass transport in nuclear waste repositories. Numerical models, in principle and if carefully constructed, should provide the most accurate basis for understanding in advance the behavior of a repository. Numerical modeling depends upon both kinetic and thermodynamic methods for realistic evaluation of mass flow rates. The purpose of this paper is to emphasize some thermodynamic methods that have not yet been exploited or that need further development to achieve the necessary resolution.

29942 (NUREG/CP—0062, pp 31-36) **Prediction of mineral solubilities and diagenesis in rock/water association at high temperature.** Moeller, N.; Weare, J.H.; Greenberg, J. (Univ. of California, San Diego). Apr 1985. NTIS, PC A06/MF A01 - GPO. File Number TI85009817. (CONF-8410234—Summs.; ORNL/TM—9585).

From Application of geochemical models to high-level nuclear waste repository assessment; Oak Ridge, TN, USA (2 Oct 1984).

To make qualitatively correct predictions of the solubility of minerals in natural brines above $I \sim .1m$, it is necessary to use thermodynamic models of high accuracy (5% in the log of the activity coefficients). This requirement results from the fact that in complex systems small errors in the calculated solution phase free energy often drastically change the predicted equilibrium solid phase assemblage. An example of the need for high accuracy is shown in the successful modeling of the complex changes which occur in the seawater equilibrium mineral assemblage during evaporation. Accurate chemical models are also required for reliable application to nuclear waste management programs. Examples of uses of such models in these programs are given.

29943 (NUREG/CP—0062, pp 69-71) **Complexes of actinides with naturally occurring compounds.** Choppin, G.R. (Florida State Univ., Tallahassee). Apr 1985. NTIS, PC A06/MF A01 - GPO. File Number TI85009817. (CONF-8410234—Summs.; ORNL/TM—9585).

From Application of geochemical models to high-level nuclear waste repository assessment; Oak Ridge, TN, USA (2 Oct 1984).

Among the variables of major influence on the chemical behavior of actinides in natural systems are redox potential, pH, complexation by inorganic ligands (particularly carbonate and hydroxide), complexation and/or reduction by organic ligands, sorption to solids and residence time. The effects of complexation and/or redox reactions with organic compounds may be very important and are examined in this paper.

29944 (NUREG/CP—0062, pp 72-73) **Determination of stability constants of the carbonate complexes of uranium and neptunium.** Maya, L. (Oak Ridge National Lab., TN). Apr 1985. NTIS, PC A06/MF A01 - GPO. File Number TI85009817. (CONF-8410234—Summs.; ORNL/TM—9585). Contract AC05-84OR21400.

From Application of geochemical models to high-level nuclear waste repository assessment; Oak Ridge, TN, USA (2 Oct 1984).

This contribution attempts to convey the difficulties and limitations encountered in obtaining stability constants of complex ions in solution. This information is of importance in developing mathematical models describing the migration of a given element in the geosphere. The difficulties in obtaining speciation schemes and therefore reliable models of migration are particularly accentuated in dealing with the actinide elements. The aqueous chemistry of these elements, under conditions similar to those found in groundwaters, is subject to a series of competing reactions, aside of adsorption phenomena which is a complex subject on its own right. The actinides undergo redox reactions, hydrolysis and complexation; mainly by carbonate, sulfate, phosphate and fluoride. Under certain circumstances, the solubilities of some of these species are exceeded and solid phases precipitate. Speciation schemes for the actinides are difficult to obtain because of the multiplicity of species that might be present at any given pH and ligand concentration. Thus an accurate representation requires consideration of all possible species and reliable stability constants for each one.

29945 (NUREG/CP—0062, pp 74-80) **Temperature dependence of actinide solubilities and speciation.** Silva, R.J. (Lawrence Berkeley Lab., CA). Apr 1985. NTIS, PC A06/MF A01 - GPO. File Number TI85009817. (CONF-8410234—Summs.; ORNL/TM—9585).

From Application of geochemical models to high-level nuclear waste repository assessment; Oak Ridge, TN, USA (2 Oct 1984).

Most of the available thermodynamic data on the nature and solubilities of compounds, as well as solution species, of the actinides U, Np, Pu and Am come from measurements made at or near 25°C. Elevated temperatures are, however, expected in a nuclear waste repository. Since oxidation state distributions, solubility product constants and formation constants for solution complexes are in general a function of temperature, one would expect the solubilities, and perhaps even the nature of stable compounds and solution species, of the actinides to change with increasing temperature in a complex way. Unfortunately, not nearly enough thermodynamic data are available at temperatures above 25°C to accurately predict solubilities as a function of temperature. However, using available data and estimates of the temperature dependence of reaction constants, one can perform equilibrium calculations that may provide information on the trends in solubilities and speciation and delineate the important parameters. This was done for U, Np, Pu and Am.

29946 (NUREG/CP—0062, pp 104-108) **Applications of geochemical modeling to high-level nuclear waste disposal at the Hanford site, Washington.** Early, T.O.; Myers, J.; Jenne, E.A. (Rockwell Hanford Operations, Richland, WA). Apr 1985. NTIS, PC A06/MF A01 - GPO. File Number TI85009817. (CONF-8410234—Summs.; ORNL/TM—9585).

From Application of geochemical models to high-level nuclear waste repository assessment; Oak Ridge, TN, USA (2 Oct 1984).

The current and projected uses of geochemical models by the Basalt Waste Isolation Project (BWIP) focus on two segments of the repository system and their associated long-term goals. These segments are the waste package and far-field environments. The long-term goals relative to the waste package environment are to: understand important solid/water reactions which control the waste package environment (Eh, pH, groundwater composition) during the thermal period; and to understand the controls on steady-state solution concentrations of key radionuclides to provide a source term for waste package radionuclide release modeling. The long-term goals relative to the far-field environment are to: understand important geochemical controls on dissolved constituents of the preemplacement groundwater flow system; provide geochemical support for conceptual groundwater flow models; and to obtain bounding information relative to the geochemical fate of radionuclides along likely flow paths to the accessible environment. Geochemical modeling applications in both areas are discussed.

29947 (NUREG/CP—0062, pp 109-110) **Matrix diffusion coefficients for the NNWSI waste package environment.** Eggert, K.G.; Revelli, M.A. (Lawrence Livermore National Lab., CA). Apr 1985. NTIS, PC A06/MF A01 - GPO. File Number TI85009817. (CONF-8410234—Summs.; ORNL/TM—9585). Contract W-7405-ENG-48.

From Application of geochemical models to high-level nuclear waste repository assessment; Oak Ridge, TN, USA (2 Oct 1984).

The Nevada Nuclear Waste Storage Investigations (NNWSI) project is evaluating the tuffaceous rock units at Yucca Mountain, located on the western boundary of the Nevada Test Site, as a potential location for a high level radioactive waste repository. Within the NNWSI project, Lawrence Livermore National Laboratory (LLNL) has been assigned responsibility for the design and qualification of the waste package. This task includes the determination of the waste package environment, the characterization of waste package-repository material interactions and the analysis and testing of the waste package performance in the repository environment. This paper describes an ongoing analysis of experimental work to determine the matrix diffusion coefficient for the NNWSI waste package environment.

29948 (NUREG/CP—0062, pp 111-112) **Applications of geochemical modeling to site characterization and radionuclide transport in the NNWSI project.** Kerrisk, J.F. (Los Alamos National Lab., NM). Apr 1985. NTIS, PC A06/MF A01 - GPO. File Number TI85009817. (CONF-8410234—Summs.; ORNL/TM—9585).

From Application of geochemical models to high-level nuclear waste repository assessment; Oak Ridge, TN, USA (2 Oct 1984).

The Nevada Nuclear Waste Storage Investigations project (NNWSI) is studying a site at Yucca Mountain, in southern Nevada, as a possible nuclear waste repository. Los Alamos National Laboratory is responsible for the geochemical aspects of site characterization at Yucca Mountain. Geochemical models are being used in site characterization to help understand (a) local water chemistry, (b) local mineralogy, (c) the relation between water chemistry and mineralogy, and (d) the effects of water chemistry and mineralogy on waste-element solubility and transport.

29949 (NUREG/CP—0062, pp 113-114) **Chemical modeling of nuclear waste repositories in the salt repository project.** Jansen, G.; Raines, G.E.; Kircher, J.F.; Hubbard, N. (Battelle Memorial Institute, Columbus, OH). Apr 1985. NTIS, PC A06/MF A01 - GPO. File Number TI85009817. (CONF-8410234—Summs.; ORNL/TM—9585).

From Application of geochemical models to high-level nuclear waste repository assessment; Oak Ridge, TN, USA (2 Oct 1984).

Salt deposits contain small amounts of water as brine in fluid inclusions in halite and in hydrous minerals, e.g., clays, kieserite ($MgSO_4 . H_2O$) and carnallite ($KMgCl_3 . 6H_2O$). For the candidate salt deposits, the total amounts of water as volume % brine are: Palo Duro Basin, Texas, approximately 1.8; Paradox Basin, Utah, approximately 5.0 for the carnallite-marker zone, and less than approximately 0.5 below this zone; Gulf Coast salt domes, less than 0.15. For the Palo Duro and Paradox salt, the brines are Mg-rich (approximately 20,000 mg/L to approximately 100,000 mg/L) and sometimes Ca-rich (up to about 20,000 mg/L) NaCl brines. Brine migration calculations have been made using calculations of the time-variant thermal gradient around the waste packages and conservatively high brine volumes in the salt (5.0 volume % for the Texas and Utah sites and 0.5 volume % for the Gulf Coast) as input data. The maximum amounts of brine that eventually migrate to each waste package are about $1.0 m^3$ (for 5.0 volume % brine) and $0.2 m^3$ (for 0.5 volume % brine). With current conceptual designs for waste package overpacks (10 to 15 cm thick low-carbon steel), the waste package is not breached by uniform corrosion within 10,000 years. In brines this material thus far shows only uniform corrosion. For the expected conditions, where the brine is provided solely by brine migration, the brine is consumed by reaction with the iron of the overpack nearly as fast as it migrates to the waste package. Therefore, for the expected conditions, data about corrosion rates, radiolysis, etc., are not important. However, it is essential that accurate volumes of in-migrating brine can be calculated.

29950 (NUREG/CR—3747) Selection and testing of rock for armoring uranium tailings impoundments. Foley, M.G.; Kimball, C.S.; Myers, D.A.; Doesburg, J.M. (Pacific Northwest Labs., Richland, WA (USA)). May 1985. Contract AC06-76RL01830. 115p. (PNL—5064). NTIS, PC A06/MF A01 - GPO. File Number TI85013799.

Pacific Northwest Laboratory has developed an approach for selecting and testing rock for its suitability and durability as armor for protecting decommissioned uranium mill tailings piles. A preliminary survey of the literature determined that existing techniques for testing rock durability were inadequate for evaluating long-term (~100 years) applications. Suites of rock samples with common lithologies and documented durations of exposure to weathering were then collected and submitted to three-axis ultrasonic testing in an attempt to develop a more reliable testing technique. We found little correlation between the duration of weathering and ultrasound velocity or attenuation in the rock. Through further study, we determined that the best screening approach incorporates common geomorphologic field collection techniques and laboratory tests. Suites of samples with known durations of exposure to weathering can be subjected to wet abrasion and wetting-drying tests to screen local rock types and select those with the greatest potential durability. Furthermore, the expected decrease of rock mass with environmental stresses (e.g., flood impingement and diurnal wetting-drying cycles) can be estimated using this approach. Further work was beyond the scope of this study. However, we are confident that this approach can determine the suitability for long-term armor of the most durable candidates using careful field sampling (including relative and absolute age-dating) and re-applying the laboratory tests. This approach, with supporting hydrologic analyses, should yield an expression of expected mass decrease as a function of time for the samples. 25 figs., 6 tabs.

29951 (NUREG/CR—3906) Uranium mill tailings neutralization: contaminant complexation and tailings leaching studies. Opitz, B.E.; Dodson, M.E.; Serne, R.J. (Pacific Northwest Labs., Richland, WA (USA)). May 1985. Contract AC06-76RL01830. 73p. (PNL—5179). NTIS, PC A04/MF A01 - GPO. File Number TI85013271.

Laboratory experiments were performed to compare the effectiveness of limestone ($CaCO_3$) and hydrated lime [$Ca(OH)_2$] for improving waste water quality through the neutralization of acidic uranium mill tailings liquor. The experiments were designed to also assess the effects of three proposed mechanisms - carbonate complexation, elevated pH, and colloidal particle adsorption - on the solubility of toxic contaminants found in a typical uranium mill waste solution. Of special interest were the effects each of these possible mechanisms had on the solution concentrations of trace metals such as Cd, Co, Mo, Zn, and U after neutralization. Results indicated that the neutralization of acidic tailings to a pH of 7.3 using hydrated lime provided the highest overall waste water quality. Both the presence of a carbonate source or elevating solution pH beyond pH = 7.3 resulted in a lowering of previously achieved water quality, while adsorption of contaminants onto colloidal particles was not found to affect the solution concentration of any constituent investigated. 24 refs., 8 figs., 19 tabs.

29952 (NUREG/CR—4134) Repository environmental parameters relevant to assessing the performance of high-level waste packages. Claiborne, H.C.; Croff, A.G.; Griess, J.C.; Smith, F.J. (Oak Ridge National Lab., TN (USA)). Feb 1985. Contract AC05-84OR21400. 123p. (ORNL/TM—9522). NTIS, PC A06/MF A01 - GPO. File Number TI85006789.

This document provides specifications for a model/methodology and approach that could be employed in determining postclosure repository environmental parameters relevant to high-level waste package performance for the Basalt Waste Isolation Project (BWIP). Guidance is provided on (1) the identity of the relevant repository environmental parameters (groundwater characteristics, temperature, radiation, and pressure), (2) the models/methodologies employed to determine the parameters, and (3) the input data base for the model/methodologies. Supporting studies included are (1) an analysis of potential waste package failure modes leading to identification of the relevant repository environmental parameters, (2) an evaluation of the credible range of the repository environmental parameters for the BWIP situation, and (3) a summary review of existing models/methodologies currently employed in determining repository environmental parameters relevant to waste package performance. 7 refs.

29953 (NUREG/CR—4161-Vol.1) Critical parameters for a high-level waste repository. Volume 1. Basalt. Binnall, E.P.; Wollenberg, H.A.; Benson, S.M.; Tsao, L.; Weres, O.; Ramirez, A.L.; Armantrout, G.A. (Lawrence Berkeley Lab., CA (USA); Lawrence Livermore National Lab., CA (USA)). May 1985. Contract W-7405-ENG-48. 93p. (UCID—20092-Vol.1). NTIS, PC A05/MF A01 - GPO. File Number TI85012798.

This report addresses critical parameters specific to a repository in basalt, using the Columbia River Basalt Group as the principal example. For the purposes of this report, a parameter is considered to be a physical property whose value helps determine the characteristics or behavior of a repository system. Parameters which are defined as critical are those essential to evaluate and/or monitor leakage of radionuclides from the repository and to evaluate the need for retrieval. The parameters are considered with respect to the disciplines of geomechanics, geology, hydrology, and geochemistry and are rank ordered in terms of importance. The specific role of each parameter, specific factors affecting the measurement of each parameter, and the interrelationships between the parameters are considered in detail. 38 refs., 1 fig., 11 tabs.

29954 (NUREG/CR—4192) Analysis of drainage and consolidation at typical uranium mill tailings sites. Fayer, M.J.; Conbere, W. (Pacific Northwest Labs., Richland, WA (USA)). May 1985. Contract AC06-76RL01830. 51p. (PNL—5421). NTIS, PC A04/MF A01 - GPO. File Number TI85013274.

The computer code TRUNC was used to analyze three aspects of uranium mill tailings dewatering: the coupling of consolidation and fluid flow, drainage design, and cover load. One-dimensional simulations of the effects of consolidation on fluid flow within a tailings pile of either slimes or a sand/slimes mix showed that drainage flux was greater for a consolidating system early in the simulation. However, after days 1400 and 160 of the simulations for the slimes and sand/slimes mix, respectively, the fluxes from the nonconsolidating systems were greater. In the sand/slimes mix, the nonconsolidating system had a cumulative flux by day 5000 that was 93% of that of the consolidating system. At the same time, in the slimes tailings piles the nonconsolidating system had a cumulative flux of only 34% of that of the consolidating system. This dif-

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ference indicates that consolidation and fluid flow should not be decoupled for the slimes. Two-dimensional simulations of an actual tailings pile drainage design showed that a sand blanket drain increased the rate of drainage and settlement. The sand blanket drain also significantly reduced differential settlement across the pile. This indicates that the use of a sand blanket drain could enable earlier placement of the cover system after tailings emplacement. In simulations of covered and uncovered tailings piles, nearly the same quantity of water was removed from each, but drainage occurred much more slowly without the cover; hence, surface settlement was slower when the tailings pile was not covered. 10 refs., 19 figs., 2 tabs.

29955 (NUREG/CR—4194) **Low-level nuclear waste shallow land burial trench isolation. Final report, October 1981-September 1984.** McCray, J.G.; Nowatzki, E.A.; Stetzenbach, K.J.; Armstrong, G. (Arizona Univ., Tucson (USA). Dept. of Nuclear and Energy Engineering). May 1985. 216p. NTIS, PC A10/MF A01 - GPO. File Number TI85901546.

This is the final report on a three year study to evaluate trench cap designs, trench construction and trench loading by accelerating the creation of void space to simulate waste degradation in order to apply stress conditions on the trench in a relatively short period of time. Eight trenches were initially constructed and instrumented, four in a semi-arid region and four in a more humid mountainous region. The concepts being tested were the "soil arch" and the "soil slab" in trench cap designs. After the first year the semi-arid site was abandoned due to cap failures. The humid site was continued to be monitored. A new trench incorporating an improved soil slab design with a wick was constructed at the location of the only failed trench at that time, at the humid site. As the result of these experiments the following conclusions have been reached: (1) Controlled compaction of backfill soils to ASTM D698 standards is not sufficient to mitigate surface subsidence in the long term. (2) Single sheet geotextile reinforcement is not adequate reinforcement for a trench cap in the shallow land burial mode. (3) A geotextile wrapped soil slab will attenuate the movement of surface subsidence and reduce surface water infiltration. (4) A steel-reinforced soil-cement slab has maintained its stability and appears to meet the requirements necessary for long term stability. (5) If the crown and cap remain stable so does the trench. Movement of water through the trench sidewalls is small and doesn't pond. (6) Aliphatic tracers performed well and dye type of tracers poorly in field use. (7) In general, tracers are feasible and effective as a trench monitoring tool. (8) Narrow designed trenches provide for improved trench cap stability. This report recommends a design for an enhanced isolation disposal trench providing improved monitoring capabilities.

29956 (NUREG/CR—4201) **Thermal stability testing of low-level waste forms.** Piciulo, P.L.; Chan, S.F. (Brookhaven National Lab., Upton, NY (USA)). May 1985. Contract AC02-76CH00016. 43p. (BNL-NUREG—51869). NTIS, PC A03/MF A01 - GPO. File Number TI85012086.

The NRC Technical Position (TP) on Waste Form specifies that waste forms should be resistant to thermal degradation. The thermal cycle testing procedure outlined in the TP on Waste Form was carried out and is believed adequate for demonstrating the thermal stability of solidified waste forms. The inclusion of control samples and the monitoring of sample temperature are recommended additions to the test. An outline for reporting thermal cycling test results is given. To produce a data base on the applicability of the thermal cycling test, the following simulated laboratory-scale waste forms were prepared and tested: boric acid and sodium sulfate evaporator bottoms, mixed bed bead resins, and powdered resins each solidified in asphalt, cement and vinyl ester-styrene. Thermal cycling does not significantly affect the compressive strength of the solidified wastes, except powdered resins solidified in cement which disintegrated during the test and bead resins in cement which showed a loss of compressive strength. After temperature cycling, cement solidified bead resins showed areas of spalling and solidified sodium sulfate forms had surface deterioration. Asphalt solidified wastes, except powdered resins, deformed by slumping on temperature cycling. Free liquid was released from vinyl esterstyrene solidifed waste forms as a result of thermal cycling. Dewatered bead and powdered resins were also tested and no free liquid was released on temperature cycling. 11 refs., 12 figs., 4 tabs.

29957 (NUREG/CR—4215) **Technical factors affecting low-level waste form acceptance criteria.** MacKenzie, D.R.; Vaslow, F.; Dougherty, D.R.; Chan, S.F. (Brookhaven National Lab., Upton, NY (USA)). May 1985. Contract AC02-76CH00016. 70p. (BNL-NUREG—51873). NTIS, PC A04/MF A01 - GPO. File Number TI85012785.

This report provides technical support to NRC in connection with the regulation 10 CFR Part 61 and NRC's Technical Position (TP) on waste form. Six specific areas are addressed, namely: the technical basis for limiting containers of radioactive gases to atmospheric pressure and 100 curies; the requirements to demonstrate that a stable waste would be recognizable for 300 or 500 years; the feasibility of achieving less than 5% deformation in buried wastes; the adequacy of ASTM tests G21 and G22 for testing for biodegradability; the adequacy of ASTM test B553 for testing for thermal degradation; and the basis for determining if a waste is explosive or pyrophoric. The principal conclusions of the report follow. A maximum pressure of 1.5 atmospheres for radioactive gases is acceptable, but the radioactivity limit should depend on the isotope, the quality of the container and the properties of the site. Site and package qualities and a wet/dry cycling test are suggested that appreciably increase the probability of indicating whether a waste would have long-term recognizability. Achieving deformation of buried waste of <5% would not be feasible using current solidification methods with either metal or polyethylene containers. ASTM tests G21 and G22, with modifications, are suitable for biodegradability testing. A modified form of ASTM B553 is adequate for thermal testing. Required information on pyrophoric and explosive materials is provided by tests given in Department of Transportation regulation 49 CFR Parts 172 and 173. 78 refs., 2 tabs.

29958 (OEFZS—4305) **Leach tests of cemented radioactive ion-exchange resins.** Patek, P. (Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H.). Dec 1984. 51p. (In German). (AV—15/84). NTIS (US Sales Only), PC A04/MF A01. File Number DE85701513.

According to the results of prior investigations, radioactive ion-exchange resins (powdered resins and bead resins) became cemented, using different recipes. In accordance with results of other investigators, referred to in the literature, it was found, that cesium is leached 250-850 tims better from the cement matrix than cobalt. Silver and cerium is retained additionally 10 times better than cobalt, so that the detection level of the gamma-multichannel spectrometer used for the evaluation, was met soon. For comparison radioactive ion-exchange resins themselves were eluted with several liquids, to study the behaviour of the pure resins during leaching conditions. Finally the compressive strength of the leached samples was determined.

29959 (ONWI—471) **Socioeconomic Data Base Report for the Paradox Basin, Utah. Letters and verification forms for personal communication data.** (Bechtel National, Inc., San Francisco, CA (USA)). May 1985. Contract AC02-83CH10140. 97p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85012385.

The letters printed in this document are references for data that appear in the study, Socioeconomic Data Base Report for the Paradox Basin, Utah (ONWI-471). The letters contain socioeconomic information and the signatures of individuals who provided specific data. This method of documentation was used to verify information that was not published in a referencible source. The following letters correspond to references that appear in the report.

29960 (PER—81, pp 40) **Review of current investigations, problems and future work with regard to radioactive waste disposal.** Hambleton-Jones, B.B. (Nuclear Development Corp. of South Africa (Pty.) Ltd., Pelindaba, Pretoria). Jan 1984. NTIS (US Sales Only), PC A04/MF A01. File Number DE85780942. (CONF-8311245—Absts.).

From Symposium for researchers in nuclear geology; Pretoria, South Africa (23 Nov 1983).

Published in summary form only.

29961 **(PNL—4980-Vol.1) Guidelines for selecting codes for ground-water transport modeling of low-level waste burial sites. Volume 1. Guideline approach.** Simmons, C.S.; Cole, C.R. (Pacific Northwest Labs., Richland, WA (USA)). May 1985. Contract AC06-76RL01830. 197p. NTIS, PC A09/MF A01; GPO Dep. File Number DE85013471.

This document was written for the National Low-Level Waste Management Program to provide guidance for managers and site operators who need to select ground-water transport codes for assessing shallow-land burial site performance. The guidance given in this report also serves the needs of applications-oriented users who work under the direction of a manager or site operator. The guidelines are published in two volumes designed to support the needs of users having different technical backgrounds. An executive summary, published separately, gives managers and site operators an overview of the main guideline report. This volume includes specific recommendations for decision-making managers and site operators on how to use these guidelines. The more detailed discussions about the code selection approach are provided. 242 refs., 6 figs.

29962 **(PNL—5414) Nuclear Waste Treatment Program. Annual report for FY 1984.** Burkholder, H.C.; Rusin, J.M. (comps.). (Pacific Northwest Labs., Richland, WA (USA)). Apr 1985. Contract AC06-76RL01830. 133p. NTIS, PC A07/MF A01; GPO Dep. File Number DE85013581.

Two of the US Department of Energy's (DOE) nuclear waste management-related goals are: (1) to ensure that waste management is not an obstacle to the further deployment of light-water reactors (LWR) and nuclear fuel cycle closure and (2) to fulfill its institutional responsibility for providing safe storage and disposal of existing and future nuclear wastes. As part of its approach to achieving those goals, the Office of Terminal Waste Disposal and Remedial Action of DOE established what is now called the Nuclear Waste Treatment Program (NWTP) at the Pacific Northwest Laboratory (PNL) during the second half of FY 1982. To support DOE's attainment of its goals, the NWTP has two objectives: (1) to provide documented technology necessary for the design and operation of nuclear waste treatment facilities by commercial enterprises as part of a licensed waste management system and (2) to provide problem-specific treatment approaches, waste form and treatment process adaptations, equipment designs, and trouble-shooting assistance, as required, to treat existing wastes. This annual report describes progress during FY 1984 toward meeting the two objectives. 31 figs., 4 tabs.

29963 **(PNL—5486) Hanford ground-water data base management guide and user's manual.** Mitchell, P.J.; Argo, R.S.; Bradymire, S.L.; Newbill, C.A. (Pacific Northwest Labs., Richland, WA (USA)). May 1985. Contract AC06-76RL01830. 87p. NTIS, PC A05/MF A01; GPO Dep. File Number DE85013279.

This management guide and user's manual is a working document for the computerized Hanford Ground-water Data Base maintained by the Geosciences Research and Engineering Department at Pacific Northwest Laboratory for the Hanford Ground-Water Surveillance Program. The program is managed by the Occupational and Environmental Protection Department for the US Department of Energy. The data base is maintained to provide rapid access to data that are rountinely collected from ground-water monitoring wells at the Hanford site. The data include water levels, sample analyses, geologic descriptions and well construction information of over 3000 existing or destroyed wells. These data are used to monitor water quality and for the evaluation of ground-water flow and pollutant transport problems. The management guide gives instructions for maintenance of the data base on the Digital Equipment Corporation PDP 11/70 Computer using the CIRMIS (Comprehensive Information Retrieval and Model Input Sequence) data base management software developed at Pacific Northwest Laboratory. Maintenance activities include inserting, modifying and deleting data, making back-up copies of the data base, and generating tables for annual monitoring reports. The user's guide includes instructions for running programs to retrieve the data in the form of listings of graphical plots. 3 refs.

29964 **(PNL-SA—12565) Operational and long-term performance assessment for Hanford Grout.** Treat, R.L.; Lokken, R.O.; Stein, S.L.; Geffen, C.A. (Pacific Northwest Labs., Richland, WA (USA)). Feb 1985. Contract AC06-76RL01830. 5p. (CONF-850314—49). NTIS, PC A02/MF A01; GPO Dep. File Number DE85010057.

From Waste management '85; Tucson, AZ, USA (24 Mar 1985).

The Department of Energy and Rockwell Hanford Operations are preparing for the construction of a Transportable Grout Facility to immobilize selected radioactive liquid wastes now stored at Hanford. Oak Ridge National Laboratory is supporting the program by developing initial grout formulations for the facility. Pacific Northwest Laboratory is verifying the required operational characteristics of the grout formulation and evaluating the long-term performance of the grouted waste form. Preliminary assessments of the operational characteristics of the grout formulation show that the grout meets established criteria. Preliminary performance assessments indicate that the grouted waste form will provide long-term environmental protection. A series of laboratory and field tests are planned and ongoing to verify these assessments. 5 refs., 4 figs.

29965 **(PNL-SA—12953) Vitrification of high-level radioactive waste in a pilot-scale liquid-fed ceramic melter.** Bjorklund, W.J.; Holton, L.K.; Knowlton, D.E. (Pacific Northwest Labs., Richland, WA (USA)). Mar 1985. Contract AC06-76RL01830. 10p. (CONF-850314—68). NTIS, PC A02/MF A01; GPO Dep. File Number DE85012447.

From Waste management '85; Tucson, AZ, USA (24 Mar 1985).

Under the sponsorship of the Nuclear Waste Treatment Program (NWTP), a high-level radioactive waste vitrification system has been installed in a Radiochemical Engineering Facility at Hanford, Washington. The facility is designed for remote operation of equipment using master-slave manipulators and overhead cranes. The pilot-scale radioactive system consists of a melter, canister handling turntable, glass-level detection system and supporting waste preparation, offgas treatment and condensate treatment systems. The vitrification system will be operated with radioactive wastes to test remote equipment features and process performance. Destructive and nondestructive methods will be used in the characterization of the waste glass product after canisters are filled with specific waste compositions. 4 refs., 9 figs.

29966 **(RFP—3746) Waste generation reduction: nitrates. FY 1984 status report.** Johnson, A.J.; Arnold, P.M. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 19 Apr 1985. Contract AC04-76DP03533. 16p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85012067.

A study was initiated at Rocky Flats Plant (RFP) to develop and demonstrate technology to eliminate nitrates in low-level waste streams without generating objectionable oxides of nitrogen. Various chemical and thermal methods of denitrification were investigated earlier in this program. Work in FY 1984 was conducted on the Thagard High Temperature Fluid Wall Reactor (HTFWR) and on an aqueous two-step process. Preliminary tests were conducted on a plasma torch system. Testing was completed with actual RFP nitrate wastes on an aqueous process consisting of formic and sulfuric acid reflux, followed by evaporation of the liquid to dryness. Results from this process show promising nitrate destruction, but with production of some NO/sub x/ in the off-gas. Also completed in aqueous testing were laser excitation techniques, indicating that the high activation energy of the nitrate ion can be overcome with a simpler chemical reaction with additional energy applied. Experiments were conducted using an HTFWR to determine its nitrate/nitrite destruction efficiency on simulated RFP and Savannah River Plant waste streams. These streams included nitrate-contaminated soils and feeds containing surrogate fission products. Various additives were tested to enhance nitrate destruction, reduce NO/sub x/ off-gas generation, and produce an acceptable final waste form.

29967 (RHO-BW-CR—143P) MAGNUM-2D computer code: user's guide. England, R.L.; Kline, N.W.; Ekblad, K.J.; Baca, R.G. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Jan 1985. Contract AC06-77RL01030. 176p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE85013315.

Information relevant to the general use of the MAGNUM-2D computer code is presented. This computer code was developed for the purpose of modeling (i.e., simulating) the thermal and hydraulic conditions in the vicinity of a waste package emplaced in a deep geologic repository. The MAGNUM-2D computer computes (1) the temperature field surrounding the waste package as a function of the heat generation rate of the nuclear waste and thermal properties of the basalt and (2) the hydraulic head distribution and associated groundwater flow fields as a function of the temperature gradients and hydraulic properties of the basalt. MAGNUM-2D is a two-dimensional numerical model for transient or steady-state analysis of coupled heat transfer and groundwater flow in a fractured porous medium. The governing equations consist of a set of coupled, quasi-linear partial differential equations that are solved using a Galerkin finite-element technique. A Newton-Raphson algorithm is embedded in the Galerkin functional to formulate the problem in terms of the incremental changes in the dependent variables. Both triangular and quadrilateral finite elements are used to represent the continuum portions of the spatial domain. Line elements may be used to represent discrete conduits. 18 refs., 4 figs., 1 tab.

29968 (RHO-BW-SA—217P) Geology and basalt stratigraphy of the Weiser embayment, west-central Idaho. Fitzgerald, J.F. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). 1984. Contract AC06-77RL01030. 139p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE85011951.

This research was conducted as part of the regional Columbia Plateau mapping effort carried out in support of the Basalt Waste Isolation Project administered for the DOE by Rockwell Hanford Operations. The purpose of this study was to examine, in detail, the Columbia River Basalt Group of the Weiser embayment and do the following: (1) complete geologic mapping of the Weiser embayment, (2) integrate observations and findings from previous field projects conducted in scattered parts of the Weiser embayment, (3) establish a stratigraphic framework for Weiser embayment basalt flows and correlate it with the Columbia River Basalt Group stratigraphic framework established by Swanson et al. (1979b), (4) determine the structural setting of the Weiser embayment and attempt to relate it to the volcanic history and postextrusion structural evolution of the Columbia Plateau. 53 refs., 27 figs., 3 tabs.

29969 (SAND—84-0637) Reduction of the well test data for test well USW H-1, adjacent to Nevada Test Site, Nye County, Nevada. Barr, G.E. (Sandia National Labs., Albuquerque, NM (USA)). May 1985. Contract AC04-76DP00789. 48p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85011866.

The drawdown and recovery data for three pump tests, three recovery tests and six injection tests in well USW H-1 are reduced to determine hydraulic conductivity and storativity, assuming the medium is homogeneous, isotropic, and porous. Conductivity ranges from about 10^{-5} m/s in the upper zone tested to 10^{-10} m/s in the lower test zone, and storativity ranges from about 5 x 10^{-7} to about 0.5. This study was conducted to support assessment of the behavior of the groundwater system at Yucca Mountain near the Nevada Test Site in southwest Nevada. After the work for the report was completed, the US Geological Survey published estimates of hydraulic conductivity based on the same test data analyzed here. This report is therefore also an independent confirmation of hydraulic conductivity estimates for well USW H-1 for the saturated zone, as well as a listing of storativity estimates. 5 refs., 23 figs., 3 tabs.

29970 (SAND—84-2015) Location recommendation for surface facilities for the prospective Yucca Mountain Nuclear Waste Repository. Neal, J.T. (Sandia National Labs., Albuquerque, NM (USA)). Apr 1985. Contract AC04-76DP00789. 59p. NTIS, PC A04/MF A01; GPO Dep. File Number DE85013169.

Six locations east of Yucca Mountain were evaluated for use as the site for repository surface facilities. Fourteen factors in three major categories were considered. These categories, in order of importance, were (1) preclosure radiological safety, (2) environmental quality, and (3) ease and cost of construction, operation, and closure. The evaluation factors and process closely followed the DOE siting guidelines (10 CFR Part 960). Site specific factors also were considered. The results indicate that the location immediately east of the northern portion of Exile Hill is preferred. We suggest the location be termed the "reference conceptual site" for use during the Conceptual Design phase of repository development. 18 refs., 2 figs., 5 tabs.

29971 (SAND—85-0807) Pretest reference calculation for the 18-W/m^2 Mockup for Defense High-Level Waste (WIPP Room A in situ experiment). Morgan, H.S.; Stone, C.M. (Sandia National Labs., Albuquerque, NM (USA)). May 1985. Contract AC04-76DP00789. 89p. NTIS, PC A05/MF A01; GPO Dep. File Number DE85012246.

A pretest reference calculation for the 18-W/m^2 Mockup for Defense High-Level Waste (DHLW) or Room A experiment is presented in this report. The mockup is one of several large scale in situ experiments currently under construction near Carlsbad, New Mexico, at the site of the Waste Isolation Pilot Plant (WIPP). The 18-W/m^2 test is an in situ experiment developed to simulate closely the Reference Repository Conditions (RRC) for DHLW in salt. The test consists of three long, parallel rooms (A1, A2, A3) which are heated by canister heaters placed in the floor of each room. These heaters produce thermal loading which simulates an areal heat output of 18-W/m^2 for Room A2, which is the focus of the experiment. This load will be supplied for a period of three years. Rooms A1, A2, and A3 are heavily instrumented for monitoring both temperature increases due to the thermal loading and deformations due to creep of the salt. Data from the experiment are not available at the present time, but the measurements for Room A2 will eventually be compared to the results for Room A2 presented here to assess and improve thermal and mechanical modeling capabilities for the WIPP. The thermal/structural model used here represents the state-of-the-art at the present time. A large number of plots are included since an appropriate result is presented for every Room A2 gauge location. 55 refs., 70 figs., 4 tabs.

29972 (SAND—85-0893) Pretest reference calculation for the 6.1 meter (20 ft) wide drifts of the Geomechanical Evaluation (WIPP Room G in situ experiment). Morgan, H.S.; Stone, C.M. (Sandia National Labs., Albuquerque, NM (USA)). Jun 1985. Contract AC04-76DP00789. 74p. NTIS, PC A04/MF A01; GPO Dep. File Number DE85012247.

A pretest reference calculation for the Geomechanical Evaluation or Room G experiment is presented. The Geomechanical Evaluation is one of several large-scale in situ tests currently under construction near Carlsbad, New Mexico, at the site of the Waste Isolation Pilot Plant (WIPP). The Room G experiment consists of isolated, two-dimensional drifts with different room spans, an isolated drift intersection, and a wedge pillar. The primary purpose of the experiment is to provide data for validating computational modeling capabilities used in analyzing nuclear waste repositories in salt. The calculation presented here addresses only one portion of the test, namely isolated drift configurations which are initially 6.1 m (20 ft) wide by 3.05 m (10 ft) high. The Geomechanical Evaluation is heavily instrumented for monitoring deformations due to creep of the salt. Data from the experiment are not available at the present time, but the measurements for Room G will eventually be compared to the results presented in this report to assess and improve structural modeling capabilities for the WIPP. The model used for this calculation represents the state of the art at the present time. A large number of plots are included since an appropriate result is presented for every gage location associated with the 6.1 m wide drifts. 53 refs., 53 figs., 3 tabs.

29973 **(SKBF-KBS-TR—79-15) Costs for handling and disposal of high level radioactive wastes and spent fuels.** Finne, A.W. (ed.). (Swedish Nuclear Fuel Supply Co., Stockholm. Div. KBS). Apr 1979. 38p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. File Number DE85701280.

This report gives a calculation of costs for the handling and final storage of spent nuclear fuel in accordance with the KBS plans. The first report deals with the handling and final storage of vitrified high level waste, while the second deals with the direct disposal of spent nuclear fuel. In both cases, the proposed facilities are designed to handle all the fuel discharged from 13 reactors over a period of 30 years of operation, corresponding to about 9000 metric tons of uranium. In reality, it may be necessary to dispose of waste in accordance with both alternatives. The initial and operating costs have been calculated in 1978 monetary values for each alternative. Reprocessing is assumed to take place abroad, and the costs for this reprocessing are not specified in this report. The costs specified therefore do not reflect the total cost of the back end of the nuclear fuel cycle, but rather only the cost of the stages studied by KBS. The total costs for the vitrified reprocessing waste alternative have been calculated to be SEK 9000 million, while the total costs for the alternative with direct disposal of unreprocessed spent fuel have been calculated to be SEK 13 500 million. This does not include VAT or costs for the handling and disposal of low- and medium-level waste, nor does it include costs for decommissioning. The cost per produced kWh has been calculated with a real interest rate of 4 per cent, in which case it is about 0.004 SEK/kWh for both alternatives. Cost calculations for facilities that are to be built and operated for such a long period of time as we are concerned with here cannot, for natural reasons, be anything other than approximate. The merit of the present calculation over such a long period of time is also dubious.

29974 **(SKBF-KBS-TR—79-28) KBS annual report 1979. Including summaries of technical reports issued during 1979.** (Swedish Nuclear Fuel Supply Co., Stockholm. Div. KBS). Mar 1980. 132p. NTIS (US Sales Only), PC A07/MF A01. File Number DE85701267.

KBS was organized by the Swedish Nuclear Power Utilities at the end of 1976. The first task was to perform the necessary studies and investigations to fulfill the requirements of a Swedish Law, demanding that the existence of a safe method for final storage of spent nuclear fuel of vitrified high-level waste must be shown before new nuclear power reactors may be taken into operation. During 1977 and 1978 two main reports have been presented on the subject. Handling of spent nuclear fuel and final storage of vitrified high-level reprocessing waste, and handling and final storage of unreprocessed spent nuclear fuel. This annual report for the KBS project gives a summary of the main activities during 1979. During the first months of the year most of the work was directed to supplementary site investigations connected with the licencing of two reactors according to the law mentioned above. After that period the responsibility of the project has been expanded to include also the low- and medium-activity waste both from reprocessing of nuclear fuel and the operations and decommissioning of nuclear power plants. After a chapter on the background of the project, the legal situation and the scientific reviews of the two main reports are presented. Chapters 4-10 present the main activities during the year within the areas of intereset for the project. In Chapter 10 (Safety Analysis) an emphasis is placed of the future plans with a discussion of areas where special efforts are needed. Chapter 11 gives an account for current and planned international cooperation in the abandoned mine at Stripa. Five appendices have been included giving 1) a list of the KBS Technical Reports issued during 1979 2) a list of authors 3) a key-word register 4) English summaries of the KBS Technical Reports and 5) SAC Technical Reports (Swedish-American cooperative investigations in the Stripa mine).

29975 **(SKBF-KBS-TR—80-24) Migration of radionuclides in fissured rock - The influence of micropore diffusion and longitudinal dispersion.** Rasmuson, A.; Neretnieks, I. (Swedish Nuclear Fuel Supply Co., Stockholm. Div. KBS). Dec 1979. 54p. NTIS (US Sales Only), PC A04/MF A01. File Number DE85701269.

The migration of radionuclides in the fissures in the bedrock surrounding a repository is discussed. A one-dimensional transport model is presented. It includes diffusion of the nuclides into the microfissures of the rock, and linear sorption and longitudinal dispersion in the bedrock. An analytical solution to the model is given in terms of an infinite integral. The integrand is a sometimes highly oscillatory function of the system parameters. A special integration method is developed to evaluate the infinite integral. The method utilizes the oscillatory behavior of the integrand. The assessment of input parameters is discussed in some detail. Dimensionless breakthrough curves are given for the approximate range of variation of the input parameters. Calculations are made for a repository of spent fuel surrounded by fissured but fairly good rock (K(sub)p=10^{-9} m/s and fissure spacing S=50 m). Longitudinal dispersion may significantly affect the amount of radioactive material reaching the biosphere. Radionuclides, which would decay completely without longitudinal dispersion, may arrive in non-negligible concentrations. Dispersion effects of the magnitude considered in this study can significantly diminish the retardation effects of matrix diffusion.

29976 **(SKBF-KBS-TR—82-28) KBS annual report 1982. Summaries of technical reports issued during 1982.** (Swedish Nuclear Fuel Supply Co., Stockholm. Div. KBS). Jul 1983. 54p. NTIS (US Sales Only), PC A04/MF A01. File Number DE85701271.

Summaries of 27 reports are listed.

The purpose of the KBS Annual Report is to inform interested organizations and individuals of the research and development work perfomed by the division KBS within the Swedish Nuclear Fuel Supply Co. (SKBF) on the handling, treatment and final storage of nuclear wastes in Sweden. In the Annual Report for 1982 the summaries of 27 technical reports and other publications issued during the year are listed.

29977 **(SKBF-KBS-TR—83-03) Smectite alteration.** Anderson, D.M. (Swedish Nuclear Fuel Supply Co., Stockholm. Div. KBS). Feb 1983. 47p. (CONF-8205301—). NTIS (US Sales Only), PC A03/MF A01. File Number DE85701272.

From Colloquium on smectite alteration; Buffalo, NY, USA (26 May 1982).

The colloquium was convened to compose a summary of the most recent data and the best scientific appraisal of present knowledge on the process of smectite conversion to illite. A brief account of a consensus view on the probable stability of smectite clays when employed as the buffer material in the Swedish nuclear fuel storage system. It is concluded that if the quantitiy of nuclear waste to be put in each bore hole is carefully limited, temperatures surrounding the cannister will not rise to an acceptable level and the clay buffer material can be relied upon to be effective throughout the life of the repository.

29978 **(SKBF-KBS-TR—83-31) Final disposal of spent nuclear fuel. Standard programme for site investigations.** Thoregren, U. (Swedish Nuclear Fuel Supply Co., Stockholm. Div. KBS). Apr 1983. 43p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85701273.

Like many other countries with similar geological conditions, Sweden plans to dispose of its long-lived radioactive nuclear waste by depositing it in final repositories located deep down in the crystalline bedrock. In order to be able to demonstrate that a given rock formation is suited for waste storage, it is necessary to have knowledge concerning its properties, particularly those that determine groundwater conditions and chemistry within the area. Also of importance are data that shed light on rock mechanics in the area and the occurrence of valuable minerals. The SKBF/KBS programme includes plans to carry out geological studies of 10-15 areas in different parts of the country during the 1980s. A standard programme for these studies is described in the following. The standard programme is intended to serve as a basis for planning of the work and revisions or modifications that may be found to be appropriate in view of local conditions or experience.

29979 (SKBF-KBS-TR—83-35) **Actinide solution equilibria and solubilities in geologic systems.** Allard, B. (Swedish Nuclear Fuel Supply Co., Stockholm. Div. KBS). Apr 1983. 56p. NTIS (US Sales Only), PC A04/MF A01. File Number DE85701275.

Stability constants and solubility products for actinide (Th, U, Np, Pu and Am) hydroxide and carbonate complexes have been collected, and total solubilities have been calculated under conditions representative of deep granitic groundwaters (pH 7-9.5; high total carbonate concentration according to log $(CO_3)=0.76pH-10.83$; redox potentials corresponding to oxic systems, $Eh>0.8-0.06pH$, and reducing systems, $Eh<0.3-0.06pH$). The solubility limiting species under reducing systems are $ThO_2(s)$, $UO_2(s)$, $NpO_2(s)$, $PuO_2(s)$ and $Am_2(CO_3)_3(s)$m, respectively, and the corresponding calculated maximum solubilities are 3 times 10^{-10} M(0.07 μg/l) for Th, 0.3-250 times 10^{-10}M (0.01-6 μg/l) for U (depending on the carbonate concentration), 1 times 10^{-10} M(0.03 μg/l) for Np, 1-3 times 10^{-9} M (0.2-0.7 μg/l) for Pu and 0.6-2 times 10^{-7} M (15-50 μg/l) for Am. The calculated solubilities for U are in fair agreement with observed uranium concentrations in natural deep groundwaters. Hexavalent uranium carbonate species would dominate in solution except under highly reducing conditions ($Eh<0.2-0.06pH$) and low total carbonate concentrations. Under oxic conditions the concentrations of U and Np would be larger than 10^{-5}-10^{-6} M (mg/l-level).

29980 (SKBF-KBS-TR—83-67, pp 2.1-2.9) **Water flow in bedrock; estimation of influence of transmissive shaft and borehole.** Andersson, L.; Neretnieks, J.; Rasmuson, A. (Royal Institute of Technology. Department of Chemical Engineering). May 1983. NTIS (US Sales Only), PC A05/MF A01. File Number DE85780814.

In Some notes in connection with the studies of final disposal of spent fuel. Pt. 2.

The bedrock is a system of large and small fractures that permit water transport through the rock mass. The water content of the bedrock can, under varying hydrostatic pressure conditions, give rise to different flow patterns via boreholes or shafts drilled through the rock. A case is dealt with where a borehole connects a low point in the terrain with a point in the repository where the hydrostatic pressure is higher than at the mouth of the borehole. The situation may be conceived as having arisen when the area was investigated and a hole was drilled at an angle down from the valley to a point below the high point in the area. If the borehole is not sealed, an artesian well may be created. The conductivity used, 2 times 10^{-9} m/s, presumes that the repository has been emplaced in average quality rock at this depth. In reality, the repository site will be selected where the rock is better than average. In reality, a shaft - even if it is imperfectly backfilled - or a borehole exerts a flow resistance that reduces the available pressure difference at a depth of 500 m. Taken together, these factors indicate that approx. 5 m^3/(year, 5 m) is the water flow that can be expected to emerge from the repository through a shaft or a borehole. Only this flow can have been contaminated with escaping substances from the repository area. Water that flows in from other parts of the hole dilutes this flow considerably.

29981 (SKBF-KBS-TR—83-67, pp 1.1-1.5) **Note on the transport of hydrogen from a waste canister.** Neretnieks, I. May 1983. NTIS (US Sales Only), PC A05/MF A01. File Number DE85780814.

In Some notes in connection with the studies of final disposal of spent fuel. Pt. 2.

Hydrogen produced by radiolysis or corrosion within the backfill can be transported out to the water in the bedrock by three mechanisms. 1. Diffusion through stagnant water in backfill and porous rock matrix. 2. Diffusion through stagnant water in backfill and into the flowing water in the fissured rock. 3. By flow as a gas if the solubility is exceeded. The first two mechanisms will transport 0.01 - 0.15 moles/year H_2 gas dissolved in water at a pressure of 50 bar.

29982 (SKBF-KBS-TR—83-67, pp 4.1-4.34) **Some simple calculations of potential fields in rock mass underneath two typified topographies.** Andersson, L.; Neretnieks, J.; Rasmuson, A. (Royal Institute of Technology. Dept. of Chemical Engineering). May 1983. NTIS (US Sales Only), PC A05/MF A01. File Number DE85780814.

In Some notes in connection with the studies of final disposal of spent fuel. Pt. 2.

Potential fields and hydraulic gradients have been calculated for some typified topographies. In one case, a high cylindrical rock mass with a radius of 250 m has been assumed to be surrounded by a 10 m wide fracture zone. The fracture zone has been assigned a conductivity 100 and 10^8 times higher than that of the rock. The conductivity of the rock decreases with depth. The rock outside the fracture zone is assumed to be impervious. A conical water mound with a height of 10 m and a radius of 100 m is placed on the cylinder, which otherwise has a flat water surface. The water mound drives the water downward and out to the fracture zone, where it flows upward. The highest gradient at repository depth (approx. 500 m) is about 10^{-3} m H_2O/m. In another case, the rock mass has been given the form of a 500 m wide vertical slab of infinite extent in the plane of the slab. The same type of fracture zone as in the cylindrical case surrounds the slab on both its vertical sides. A water ridge with a height of 10 m and a 200 m base is placed symmetrically on the top surface of the slab. The maximum gradient at a depth of 500 m is now about 7 times 10^{-3} m H_2O/m. An isolated water mound contributes little towards driving the water at great depths. An elongated ridge has a greater influence. In a rock with a hydraulic conductivity of 10^{-10} m/s at a depth of 500 m, the flow in the ridge case would be about 0.02 $1/m^2$ year.

29983 (SKBF-KBS-TR—83-67) **Some notes in connection with the studies of final disposal of spent fuel. Pt. 2.** Neretnieks, I. (Swedish Nuclear Fuel Supply Co., Stockholm. Div. KBS). May 1983. 77p. NTIS (US Sales Only), PC A05/MF A01. File Number DE85780814.

Individual papers were processed separately for inclusion in the Energy Data Base.

29984 (SKBF-KBS-TR—83-70) **Analysis of groundwater from deep boreholes in Kamlunge.** Laurent, S. (Swedish Nuclear Fuel Supply Co., Stockholm. Div. KBS). May 1983. 54p. NTIS (US Sales Only), PC A04/MF A01. File Number DE85701276.

Groundwater from four boreholes in granitic rock at an investigation site in Kamlunge has been sampled and analysed. This is part of a larger program of geological, geophysical and hydrogeological investigations aimed at finding a suitable site for a high-level radioactive waste repository. One to four water-bearing levels in each borehole between a depth of 100 and 600 m were selected. Prior to sampling, the water-bearing level is isolated between packer sleeves. The water is then pumped to the surface where sensitive parameters such as redox potential, pH, sulphide and oxygen content are measured electrochemically on the flowing water in a system isolated from the air. Water, filter and gas samples are sent to several laboratories for further analysis. The present report is a presentation of the results of the groundwater analyses. The reliability of the results is discussed but there is no evaluation in relation to geology and hydrogeology. This report presents the basic results from the groundwater analyses to be further evaluated by experts in different fields.

29985 (SKBF-KBS-TR—83-77) **KBS Annual Report 1983. Including summaries of technical reports issued during 1983.** (Swedish Nuclear Fuel Supply Co., Stockholm. Div. KBS). Jun 1984. 250p. NTIS (US Sales Only), PC A11/MF A01. File Number DE85701277.

Summaries of 76 reports are listed.

The purpose of the KBS Annual Report is to inform interested organizations and individuals of the research and development work performed by the division KBS within the Swedish Nuclear Fuel Supply Co (SKBF) on the handling, treatment and final storage of nuclear wastes in Sweden. The Annual Report normally contains a presentation of the legal and organizational situation followed by an account of the progress within different areas of the R and D-work. This account also includes indications of the activities planned for the future. At the end of the report the summaries of 76 technical reports and other publications issued during the year are listed in special appendices.

29986 **(SKBF-KBS-TR—84-03) Effect of β-radiolysis on the products from α-radiolysis of ground water.** Christensen, H.; Bjergbakke, E. (Swedish Nuclear Fuel Supply Co., Stockholm. Div. KBS). Jul 1984. 22p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85701278.

In a previous study it has been shown that α-radiolysis of a thin water film on spent fuel stored in copper canister may result in formation of substantial amounts of hydrogen and oxygen. In the present investigation the effect of low LET radiation, such as γ- and β-radiations, on these molecules when they diffuse out of the α-irradiated layer has been calculated using a computerized radiation chemical program. It has been found that low LET radiation under certain conditions may act as a recombiner for hydrogen and oxygen produced by α-radiolysis. The effect of γ-radiation outside the canister is small - due to the low dose rates prevailing there. However, the relatively high β-radiation field existing inside the fuel cladding recombines the major part of the hydrogen and oxygen produced by α-radiolysis of pure water, in particular if the gases have to diffuse out through bentonite.

29987 **(SSI-A—84-04) Examination of KBS-3 by SSI.** (Statens Straalskyddsinstitut, Stockholm (Sweden)). Feb 1983. 177p. (In Swedish). NTIS (US Sales Only), PC A09/MF A01. File Number DE85701279.

The National Institute of Radiation Protection has examined the basis for the application of the permission to load the nuclear reactors Forsmark-3 and Oskarshamn-3, regarding the special nuclear law. The Institute finds that the proposed method for handling and final disposal of spent nuclear fuel will comply with the above mentioned law regarding radiation protection. The law also requires a programme for research and development. No such programme has been distributed.

29988 **(UCRL—15667) Permeability and fluid chemistry studies of the Topopah Spring Member of the Paintbrush Tuff, Nevada Test Site: Part II.** Moore, D.E.; Morrow, C.A.; Byerlee, J.D. (Geological Survey, Menlo Park, CA (USA)). Mar 1985. Contract W-7405-ENG-48. 44p. (SANL—126-016). NTIS, PC A03/MF A01; GPO Dep. File Number DE85012967.

Open-File Report 84-848.

The Topopah Spring Member of the Paintbrush Tuff is being considered as a possible emplacement horizon for the disposal of nuclear waste. The permeability and pore-fluid chemistry of the Topopah Spring Member have been investigated experimentally. The work reported here represents a continuation of previous permeability studies on the Topopah Spring Member. Three experiments were run, to test the effect of pore pressure, sample orientation, and flow direction on permeability and pore fluid chemistry. In the experiments, water flowed either up or down a temperature gradient established across the tuff sample in response to a small pore pressure gradient. The maximum temperature of the gradient was 150°C, and the minimum was 43 to 45°C. The confining pressure was 100 bars, corresponding to a disposal depth of 400 meters. J13 water was the starting pore fluid. The heated tuff samples showed few changes in permeability from their initial, room-temperature values. In addition, the fluids discharged from both the low and high-temperature sides of the tuff samples were dilute, nearly neutral solutions whose compositions did not differ greatly from the starting J13 compositions. 16 refs., 14 figs., 4 tabs.

29989 **(UCRL—53381) Structural geology report: Spent Fuel Test - Climax Nevada Test Site.** Wilder, D.G.; Yow, J.L. Jr. (Lawrence Livermore National Lab., CA (USA)). Oct 1984. Contract W-7405-ENG-48. 45p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85012542.

We performed underground mapping and core logging in the Climax Stock, a granitic intrusive at the Nevada Test Site, as part of a major field test to determine the feasibility of using granitic or crystalline rock for the underground storage of spent fuel from a nuclear reactor. This mapping and logging identified more than 2500 fractures, over 1500 of which were described in enough detail to allow statistical analyses and orientation studies to be performed. We identified eight joint sets, three major shear sets, and a fault zone within the Spent Fuel Test - Climax (SFT-C) portion of the Stock. Joint sets identified within the SFT-C and elsewhere in the Stock correlated well. The orientations of joint sets identified by other investigators were consistent with our findings, indicating that the joint sets are persistent and have a relatively uniform orientation throughout a major portion of the Stock. The one joint set not seen elsewhere in the Stock is healed and the wall rock is altered, implying that healed joints were not included in the mapping criteria used by other investigators. The shear sets were distinguished from the joint sets by virtue of crushed minerals, continuous clay infilling, and other evidences of shearing, and from faults by the lack of offsetting. Previous investigators working mainly in the Pile Driver Drifts identified two of the shear sets. The third set, being nearly parallel to these Drifts had not been identified previously. The fault zone identified at the far (Receiving Room) end of the project is oriented approximately N45°E-75°SE, similar to both the Boundary and Shaft Station Faults. We have, therefore, concluded that the Receiving Room Fault is one of a series of normal faults that occur within the Climax Stock and that are possibly related, in both age and genesis, to the Boundary Fault. 52 refs., 26 figs., 11 tabs.

29990 **(USGS-OFR—85-224) Uranium, thorium isotopic analyses and uranium-series ages of calcite and opal, and stable isotopic compositions of calcite from drill cores UE25a No. 1, USW G-2 and USW G-3/GU-3, Yucca Mountain, Nevada.** Szabo, B.J.; Kyser, T.K. (Geological Survey, Denver, CO (USA)). 1985. Contract AI08-78ET44802. 29p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85013039.

Fracture and cavity filling calcite and opal in the unsaturated zone of three drill cores at Yucca Mountain were analyzed for uranium and stable isotope contents, and were dated by the uranium-series method. Stable isotope data indicate that the water from which the calcite precipitated was meteoric in origin. The decrease in ^{18}O and increase in ^{13}C with depth are interpreted as being due to the increase in temperature in drill holes corresponding to an estimated maximum geothermal gradient of 43° per km. Of the eighteen calcite and opal deposits dated, four of the calcite and all four of the opal deposits yield dates older than 400,000 years and ten of the remaining calcite deposits yield dates between 26,000 and 310,000 years. The stable isotope and uranium data together with the finite uranium-series dates of precipitation suggest a complex history of fluid movements, rock and water interactions, and episodes of fracture filling during the last 310,000 years. 10 refs., 7 figs., 4 tabs.

29991 **(Y/OWI/SUB—7414/1) Salt deposits in the United States and regional geologic characteristics important for storage of radioactive waste.** Johnson, K.S.; Gonzales, S. (Oklahoma Univ., Norman (USA); Georgia Univ., Athens (USA); Earth Resource Associates, Inc., Athens, GA (USA)). Mar 1978. Contract AC05-84OR21400. 192p. NTIS, PC A09/MF A01; GPO Dep. File Number DE85013319.

A repository for radioactive waste must isolate radionuclides from the biosphere for long periods of geologic time, during which time the radionuclides would decay to the point where they no longer represent a hazard to man and his ecosystem. Burial of waste in a solidified form in subsurface geologic formations has been considered the most effective and most practical means of isolation, and the characteristics of thick deposits of rock salt make these deposits a desirable medium for such geologic isolation. This report brings together an extensive body of data on the distribution and geology of rock-salt deposits in the United States and discusses for each salt deposit the regional geologic characteristics that relate to its general suitability for the possible storage or disposal of radioactive waste. These regional geologic characteristics include the thickness, depth, lateral continuity, homogeneity, and dissolution of salt beds, as well as the geologic structure, hydrology, and seismic activity of the region. Other characteristics include the nature of rock units adjacent to the salt, the potential for present or future development of mineral resources, and the location of boreholes and other man-made excavations that penetrate the salt. 282 refs., 68 figs., 3 tabs.

29992 Porous metal filter collects radioactive strontium in hot cell operation. Fulton, J.; Hodel, A.E. (Rockwell Hanford Operations, Richland, WA). *Chemical Processing (Chicago);* 88-89(Mar 1985).

The separation of a purified inorganic salt from a batch of slurry containing a high level radionuclide presented some unusual requirements at Rockwell Hanford's fission products production facility in Richland, WA. The product, radioactive strontium, is encapsulated as purified strontium fluoride after the recovered precipitate is sintered in a furnace to drive off all volatiles. The separation process required a filter to collect the finely divided strontium fluoride particles. The filter is required to withstand temperatures of 300-400°C and maintain chemical stability in high levels of radioactivity. The filter also has to be sturdy enough to be manageable by a remote master/slave electromechanical manipulator in a hot cell. In addition, the filter must withstand a corrosive environment where the potential of traces of hydrofluoric acid exists. A uniformly permeable filter medium with low pressure drop and high particulate removal efficiency was necessary to ensure total recovery and clean filtrate. Strontium fluoride is precipitated batchwise from a reaction between sodium fluoride and strontium nitrate. After chemical adjustments are completed, the whole batch is filtered through a bank of four vacuum filters which contain a porous metal filter medium. Cylinders of sintered porous stainless steel were chosen as the filter medium because they were adaptable to the handling requirements and met the stringent separation criteria. The overall reaction-to-encapsulation operation at Rockwell Hanford has been developed to achieve better than 99% recovery of the strontium. The consistent performance of the porous metal cartridge filter medium has played an important part in maintaining this high recovery.

29993 Method for recovery of actinides from actinide-bearing scrap and waste nuclear material using O_2F_2. Asprey, L.B.; Eller, P.G. (to Dept. of Energy). US Patent Application 6-649,626. 12 Sep 1984. 8p. Contract W-7405-ENG-36.

Method for recovery of actinides from nuclear waste material containing sintered and other oxides thereof and from scrap materials containing the metal actinides using O_2F_2 to generate the hexafluorides of the actinides present therein. The fluorinating agent, O_2F_2, has been observed to perform the above-described tasks at sufficiently low temperatures that there is virtually no damage to the containment vessels. Moreover, the resulting actinide hexafluorides are not detroyed by high temperature reactions with the walls of the reaction vessel. Dioxygen difluoride is readily prepared, stored and transferred to the place of reaction.

29994 Interim stabilization of uranium mill tailings. Elmore, M.R.; Hartley, J.N.; Li, C.T. (Battelle Pacific Northwest Lab., Richland, WA). pp 91-99 of Uranium Mill Tailings Management. Nelson, J.D. Fort Collins, CO; Colorado State Univ. (1982). (CONF-821209—).

From 5. annual symposium on uranium mill tailings management; Ft. Collins, CO, USA (9 Dec 1982).

This paper presents the results of a literature review of dust suppression technology and laboratory screening tests, and describes a field test conducted at a uranium mill. Thirty four chemical stabilizers were evaluated in a series of laboratory wind tunnel tests performed at the Pacific Northwest Laboratory. The most effective stabilizers identified during the laboratory screening tests were applied to the surface of uranium mill tailings at a mill in Wyoming. Topics considered include sources of fugitive dust, mechanisms of wind erosion, fugitive dust control methods (physical methods, chemical methods, biological methods), and selecting a stabilizer. It is concluded that the selection of the most appropriate method depends on site-specific conditions, including tailings particle size distribution, tailings chemistry, climate, site preparation requirements, and potential environmental effects.

29995 Evaluation of inactive uranium mill tailings sites for liner requirements: Characterization and interaction of tailings, soil, and liner materials. Relyea, J.F.; Martin, W.J. (Battelle Pacific Northwest Lab., Richland, WA). pp 507-519 of Uranium Mill Tailings Management. Nelson, J.D. Fort Collins, CO; Colorado State Univ. (1982). (CONF-821209—).

From 5. annual symposium on uranium mill tailings management; Ft. Collins, CO, USA (9 Dec 1982).

This paper summarizes the results of laboratory experiments using soils from Clive, Utah and tailings samples from three inactive uranium processing sites. The results are to be used to predict contaminant behavior for comparison with the regulatory criteria to decide whether a liner is needed. The interactions of leachates with soils and liner material were studied using both batch and column methods. It is determined that batch leaching tests are suitable for screening a large number of tailings samples for relative contaminant concentrations between samples but not for determining contaminant concentrations and release rates in tailings leachate. The results of column leaching tests on samples of tailings from inactive sites indicate that contaminant concentrations are highest in initial leachate from the columns and that concentrations decrease by an order of magnitude or more after one pore volume.

29996 Recent hydrological observations from the Riverton and Maybell tailings piles. Tokunaga, T.; Narasimhan, T.N. (Lawrence Berkeley Lab., Univ. of California, Berkeley, CA). pp 463-473 of Uranium Mill Tailings Management. Nelson, J.D. Fort Collins, CO; Colorado State Univ. (1982). (CONF-821209—).

From 5. annual symposium on uranium mill tailings management; Ft. Collins, CO, USA (9 Dec 1982).

This paper reports on field and laboratory hydrologic studies of two inactive uranium mill tailings piles under the Uranium Mill Tailings Remedial Action Program (UMTRA). The ultimate goal of the studies is to evaluate the nature of the contaminant potential of the piles with sufficient detail so that appropriate remedial measures can be designed and implemented under the UMTRA Program. The field studies included the monitoring of hydraulic head profiles of the piles and infiltration tests. Both the field and laboratory results from the Riverton tailings indicate a great deal of spatial variability in hydraulic properties. It is determined that the bulk of the precipitation input at the Riverton tailings is lost by evapotranspiration within the upper meter of soil cover and tailings.

29997 A field experiment on tailings reclamation: radon flux versus earthen cover depth. Hinton, T.; Whicker, F.W. (Pathfinder Mines Corp., Shirley Basin, WY). pp 421-432 of Uranium Mill Tailings Management. Nelson, J.D. Fort Collins, CO; Colorado State Univ. (1982). (CONF-821209—).

From 5. annual symposium on uranium mill tailings management; Ft. Collins, CO, USA (9 Dec 1982).

Design and construction techniques are described for a 1.6 hectare (4 acre) experimental uranium tailings reclamation plot. A brief review of the objectives of the experiment are discussed along with initial survey methods used to characterize the plot. These include analysis of the source term, overburden, first year vegetation, moisture determination with a neutron probe and gross alpha and gamma surveys. The radon exhalation versus overburden depth experiment is discussed in detail. Radon flux from tailings covered with 1.5 m (5') or more of earthen material was not distinguishable from background fluxes. Problems associated with high variability among replicates within the same treatment areas are discussed.

29998 Effect of rock cover on multilayer radon barrier effectiveness. Kirkham, R.R.; Beedlow, P.A.; Gee, G.W. (Battelle Pacific Northwest Lab., Richland, WA). pp 409-419 of Uranium Mill Tailings Management. Nelson, J.D. Fort Collins, CO; Colorado State Univ. (1982). (CONF-821209—).

From 5. annual symposium on uranium mill tailings management; Ft. Collins, CO, USA (9 Dec 1982).

This paper presents the field data collected to evaluate the effect of vegetation and rock covers on multilayer radon barriers and provides data for modeling studies. Radon flux and soil moisture data were collected to determine the effect of vegetation and rock erosion control covers on a multilayer barrier. The multilayer barrier is composed of a low-porosity, clay-rock mixture hydrologically isolated by a gravel layer from the protective overburden soil material. The results indicate that the rock barrier increased the soil moisture content of the underlying soils. It is concluded that if rock covers are used as stabilization treatments in remedial action programs, new measurement procedures must eliminate the measurement inaccuracies caused by rock covers.

29999 **A systematic approach to designing surface covers for uranium mill tailings.** Beedlow, P.A.; Cadwell, L.L.; McShane, M.C. (Pacific Northwest Lab., Richland, WA). pp 397-407 of Uranium Mill Tailings Management. Nelson, J.D. Fort Collins, CO; Colorado State Univ. (1982). (CONF-821209—).

From 5. annual symposium on uranium mill tailings management; Ft. Collins, CO, USA (9 Dec 1982).

The wide range of existing environmental conditions and available cover materials at uranium mill tailings sites precludes the use of a single surface cover for effective long-term erosion resistance. The UMTRA program is developing site-specific guidelines for designing effective and lasting surface covers. This paper presents a systematic approach to designing surface covers for tailings that can be tailored to conditions at any site. The approach consists of three phases: 1) An assessment, during which the degree of required surface protection (erosion potential) is determined. 2) A preliminary design that integrates surface cover design with the need to minimize transport of radon and leachates from the tailings. 3) A final design, where the cost and effectiveness of the surface cover are determined.

30000 **Cost and effectiveness of radon barrier systems.** Baker, E.G.; Freeman, H.D.; Gee, G.W.; Hartley, J.N. (Pacific Northwest Lab., Richland, WA). pp 383-395 of Uranium Mill Tailings Management. Nelson, J.D. Fort Collins, CO; Colorado State Univ. (1982). (CONF-821209—).

From 5. annual symposium on uranium mill tailings management; Ft. Collins, CO, USA (9 Dec 1982).

This paper estimates the cost of the earthen, asphalt, and multilayer covers for three tailings piles designated high priority by the US DOE. The sensitivity of the cost of the radon barrier systems to the radon flux reduction which must be achieved, the amount of cover material required to obtain the desired flux reduction, and the exact location of the disposal sites is examined. The three types of covers were field tested at the Pacific Northwest Laboratory. The cost estimates for the three high priority western sites indicate that 3m of earthen cover is the least costly radon barrier when earthen material is available at or near the disposal site.

30001 **Radon emanation characteristics of uranium mill tailings.** Nielson, K.K.; Freeman, H.D.; Hartley, J.N.; Mauch, M.L.; Rogers, V.C. (Rogers & Associates Engineering Corp., Salt Lake City, UT). pp 355-367 of Uranium Mill Tailings Management. Nelson, J.D. Fort Collins, CO; Colorado State Univ. (1982). (CONF-821209—).

From 5. annual symposium on uranium mill tailings management; Ft. Collins, CO, USA (9 Dec 1982).

Radon emanation from uranium mill tailings was examined with respect to the mechanisms of emanation and the physical properties of the tailings which affect emanation. Radon emanation coefficients were measured at ambient moisture on 135 samples from the 1981 field test site at the Grand Junction tailings pile. These coefficients showed a similar trend with moisture to those observed previously with uranium ores, and averaged 0.10 + or - 0.02 at dryness and 0.38 + or - 0.04 for all samples having greater than five weight-percent moisture. Small differences were noted between the maximum values of the coefficients for the sand and slime fractions of the tailings. Separate measurements on tailings from the Vitro tailings pile exhibited much lower emanation coefficients for moist samples, and similar coefficients for dry samples. Alternative emanation measurement techniques were examined and procedures are recommended for use in future work.

30002 **Interaction of acidic leachate with soil materials at Lucky McPathfinder mill, Gas Hills, Wyoming.** Erikson, R.L.; Sherwood, D.R. (Pacific Northwest Lab., Richland, WA). pp 335-351 of Uranium Mill Tailings Management. Nelson, J.D. Fort Collins, CO; Colorado State Univ. (1982). (CONF-821209—).

From 5. annual symposium on uranium mill tailings management; Ft. Collins, CO, USA (9 Dec 1982).

This paper investigates the interaction of tailings liquor with sediments beneath an evaporation pond. The problems examined include the transport of radionuclides through pond sediments, the advance of the pH front, and mineralogical changes caused by soil/leachate content. The results are used to document the effectiveness of the native soil as a barrier for the transport of contaminants and as a qualitative indicator of the chemical stability of the mineral assemblage in the native soil. Sediment samples were collected to depths of 60 cm at six locations on the pond bottom while the pond was temporarily drained. The results indicate that the Forelle-Patent alluvium is an effective barrier to radionuclide migration. It is determined that the radionuclide concentrations on the soil profile are near background levels at a depth of 60 cm whereas the calculated solution seepage front may have reached 11.4 m in the 4-yr contact time.

30003 **Chemical transport beneath a uranium mill tailings pile, Riverton, Wyoming.** White, A.F.; Delany, J.M. (Lawrence Berkeley Lab., Univ. of California, Berkeley, CA). pp 295-313 of Uranium Mill Tailings Management. Nelson, J.D. Fort Collins, CO; Colorado State Univ. (1982). (CONF-821209—).

From 5. annual symposium on uranium mill tailings management; Ft. Collins, CO, USA (9 Dec 1982).

This paper reports on a detailed geochemical study conducted at the Riverton site in order to define the nature of chemical transport between an inactive tailings pile and the relationships between the underlying shallow groundwater system. Topics considered include regional isotope hydrology and geochemistry, evidence for the chemical contamination of shallow aquifers, and chemical reactions. The chemical speciation code, PHREEQE, was used to model mixing reactions, assuming a hydrologically static system. The simulations estimate one percent mixing of tailings-pore water with groundwater from the shallow alluvial aquifer.

30004 **Riprap Design considerations for long-term protection of uranium mill tailings.** Walters, W.H. (Battelle Pacific Northwest Lab., Richland, WA). pp 117-126 of Uranium Mill Tailings Management. Nelson, J.D. Fort Collins, CO; Colorado State Univ. (1982). (CONF-821209—).

From 5. annual symposium on uranium mill tailings management; Ft. Collins, CO, USA (9 Dec 1982).

As part of a Nuclear Regulatory Commission (NRC) study to assess the long-term protection of retired uranium mill tailings, the Pacific Northwest Laboratory (PNL) has reviewed the processes of water erosion and the protection requirements of earthen radon suppression covers. Existing and proposed designs of the covers are briefly presented here. The Riprap Design with Safety Factor Method is recommended for uranium mill tailings impoundments. The basic steps required in designing riprap to protect against flood erosion are discussed in this paper and other design criteria related to the problems of long-term protection are identified.

30005 **A review of long-term rock durability: Implications for survivability of riprap used to protect uranium mill tailings.** Lindsey, C.G.; Doesburg, J.M.; Vallario, R.W. (Pacific Northwest Lab., Battelle Memorial Inst., Richland, WA). pp 101-115 of Uranium Mill Tailings Management. Nelson, J.D. Fort Collins, CO; Colorado State Univ. (1982). (CONF-821209—).

From 5. annual symposium on uranium mill tailings management; Ft. Collins, CO, USA (9 Dec 1982).

This paper reviews information on rock weathering and riprap durability. Chemical and physical weathering processes, rock characteristics related to durability, and the role of climate in rock weathering are discussed. Current testing procedures for assessing riprap durability, and the reliability of these procedures, are examined. Salient geological and petrological properties of rock that may be selected for use as uranium mill tailings riprap are investigated. It is determined that riprap durability depends on the weathering environment and the lithological properties of the material chosen for the riprap. The results indicate that certain rock types may be suitable for mill tailings armoring, including varieties of igneous rocks (e.g., rhyolites and fine-granitic gneisses), and perhaps a few sedimentary rocks and granitic gneisses), and perhaps a few sedimentary rocks (e.g. limestones).

30006 **Interior drains for open pit disposal of uranium mill tailings.** Staub, W.P. (Oak Ridge National Lab., Oak Ridge, TN). pp 113-126 of Uranium Mill Tailings Management, Vol. II. Nelson, J.D. Fort Collins, CO; Colorado State Univ. (1978). (CONF-781127—).

From Symposium on uranium tailings disposal; Fort Collins, CO, USA (20 Nov 1978).

A conceptualized interior drainage system is presented for reducing the environmental impact on natural groundwater by disposal of uranium mill tailings in a mined-out open pit. The evaporation/seepage ratio can be increased through the use of interior drains, long-term monitoring of groundwater quality can be eliminated, and the open pit will not require an extensive liner. Other advantages not related to groundwater are: control of fugitive dust and radon emanation during mill operations and timely reclamation after the impoundment is filled with tailings.

0530 Environmental Aspects

REFER ALSO TO CITATION(S) 29930, 29947, 29951, 29954, 29961, 29995, 29996, 29997, 29998, 29999, 30000, 30001, 30002, 31641, 32382, 32408

30007 (AECL—8253) **Migration of radionuclides in unconsolidated materials. Equilibrium transport models.** Moltyaner, G.L. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Dec 1983. 29p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85701514.

Analytical models for predicting radionuclide transport in shallow groundwater flow systems are developed. General-form solutions for a single radionuclide and for a multi-member decay chain of radionuclides are given for semi-infinite media. The solutions are presented for the first and third type time-dependent boundary conditions (time-dependent concentration and time-dependent flux at the hypothetical radionuclide emergence zone from the hard rock formations in the shallow groundwater system). Solutions for a single radionuclide are presented for several types of radionuclide input conditions, which provide a means for determining physiochemical parameters controlling radionuclide transport in porous media. Although the solutions for multi-member decay chains are derived for specific types of conditions, to allow for time delay from the vault to the biosphere, the results can be easily extended to any type of input conditions through the use of the superposition principle.

30008 (AERE-R—11240) **Migration processes in a model deep repository for the disposal of intermediate level nuclear waste.** Sharland, S.M.; Tasker, P.W. (UKAEA Atomic Energy Research Establishment, Harwell. Theoretical Physics Div.). Jun 1984. 56p. HMSO, London, price Pound 5.00.

It is difficult to conceive of radionuclides escaping from a repository by any means other than migration in groundwater. Simple models of the repository are constructed and various migration processes are identified and assessed, according to the flow speed of water through the repository. Diffusion in static water and advection in fast flows are considered separately initially, but later we examine the effect of slow flows in which both these processes contribute to the removal of radionuclides. Concentration profiles across the repository, fluxes of nuclides and total losses are obtained from the analysis. We investigate the time scales necessary for the steady state to be achieved in the repository and conclude that flow speed is roughly inversely proportional to this time scale, i.e. faster flows establish a steady state sooner than slow ones. We also assess the sensitivity of the results to the physical properties of the components of the repository.

30009 **(CONF-840806—Vol.1) 18th DOE nuclear airborne waste management and air cleaning conference: proceedings. Volume 1.** First, M.W. (ed.). (USDOE, Washington, DC; Harvard Univ., Boston, MA (USA). Harvard Air Cleaning Lab.). Mar 1985. 827p. NTIS, PC A99/MF A01; 1; GPO Dep. File Number DE85012484.

From 18. DOE nuclear airborne waste management and air cleaning conference; Baltimore, MD, USA (13 Aug 1984).

Individual items have been processed separately for the various data bases.

30010 **(CONF-840806—Vol.2) 18th DOE nuclear airborne waste management and air cleaning conference: proceedings. Volume 2.** First, M.W. (ed.). (USDOE, Washington, DC; Harvard Univ., Boston, MA (USA). Harvard Air Cleaning Lab.). Mar 1985. 855p. NTIS, PC A99/MF A01; 1; GPO Dep. File Number DE85012485.

From 18. DOE nuclear airborne waste management and air cleaning conference; Baltimore, MD, USA (13 Aug 1984).

Individual items have been processed separately for the various data bases.

30011 (NIRS-M—41, pp 242-261) **Tritium transport around nuclear faciliteis.** Murphy, C.E. Jr.; Sweet, C.W. (Savannah River Ecology Lab., Aiken, SC (USA)). Mar 1982. NTIS (US Sales Only), PC A15/MF A01. File Number DE85781031. (CONF-811082—).

From Workshop on tritium radiobiology and health physics; Chiba, Japan (1 Oct 1981).

The transport and cycling of tritium around nuclear facilities is reviewed with special emphasis on studies at the Savannah River Laboratory, Aiken, South Carolina. These studies have shown that the rate of deposition from the atmosphere, the site of deposition, and the subsequent cycling are strongly influenced by the compound with which the tritium is associated. Tritiated hydrogen is largely deposited in the soil, while tritiated water is deposited in the greatest quantity in the vegetation. Tritiated hydrogen is converted in the soil to tritiated water that leaves the soil slowly, through drainage and transpiration. Tritiated water deposited directly to the vegetation leaves the vegetation more rapidly after exposure. Only a small part of the tritium entering the vegetation becomes bound in organic molecules. However, it appears that the existence of soil organic compounds with tritium concentrations greater than the equilibrium concentration in the associated water can be explained by direct metabolism of tritiated hydrogen in vegetation.

30012 (NIRS-M—41, pp 271-284) **Environmental tritium monitoring around Tokai Reprocessing Plant.** Yamato, A. (Power Reactor and Nuclear Fuel Development Corp., Tokai, Ibaraki (Japan). Tokai Works). Mar 1982. NTIS (US Sales Only), PC A15/MF A01. File Number DE85781031. (CONF-811082—).

From Workshop on tritium radiobiology and health physics; Chiba, Japan (1 Oct 1981).

The environmental tritium monitoring in the sea near Tokai Reprocessing Plant has been performed since 1977, the year of having started the hot test operation of the plant. On the other hand, atmospheric tritium monitoring was started almost at the same time as a research program instead of a routine program. This paper is a review for tritium monitoring in the sea and in the air around the Tokai Reprocessing Plant. The plant is located in Tokai Village, Ibaraki Prefecture, on the Pacific coast. It is based on the Purex process, and the nominal capacity is 210 tons per year. Around the TRP, there are four uranium fabrication facilities, five research reactors, two power reactors and other research facilities. About 173,000 inhabitants are within 10 km range from the plant. The authorized discharge limit of tritium is 200 Ci per day and 51,100 Ci per year in the sea. That in the atmosphere is 50 Ci per day and about 15,000 Ci per year. The tritium from the TRP was discharged mainly into the sea. The sea water samples were distilled, and the tritium concentration was measured by liquid scintillation counting. During three years of the hot operation of TRP, discharged tritium was about 7,000 Ci into the sea and about 140 Ci into the atmosphere. The tritium level has been maintained, and its significant increase was not observed.

30013 **(OSS/RR—3) Limnological survey of the Alligator Rivers Region. 1. Diatoms (Bacillariophyceae) of the region.** Thomas, D.P. (Office of the Supervising Scientist for the Alligator Rivers Region, Sydney (Australia)). Aug 1983. 152p. NTIS (US Sales Only), PC A08/MF A01. File Number DE85701052.

This study was undertaken as part of a study of the algae of the Alligator Rivers Region in general, and of the Magela Creek in particular, to support an investigation into the possible use of native algae as an indicator of any changes in water quality which might occur as a result of uranium mining and milling in the Region.

30014 **(OSS/TM—6) Dietary pathways through lizards of the Alligator Rivers Region.** James, C.D.; Morton, S.R.; Braithwaite, R.W.; Wombey, J.C. (Office of the Supervising Scientist for the Alligator Rivers Region, Sydney (Australia)). Jul 1984. 15p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85701053.

A broad survey of the diets of 46 species of terrestrial and arboreal lizards from the families Gekkonidae, Pygopodidae, Agamidae and Scincidae was carried out in the Alligator Rivers Region, and the diets of three of the species were examined in detail by monthly sampling near the Ranger uranium mine. The study shows that, in the event of contamination of the waterbodies, only two species of lizards face any risk of contamination through their food.

30015 **(PER—81, pp 41, 43) Geobotanical investigation of the Vaalputs Site.** Lloyd, J.W. (Cape Town Univ. (South Africa)). Jan 1984. NTIS (US Sales Only), PC A04/MF A01. File Number DE85780942. (CONF-8311245—Absts.).

From Symposium for researchers in nuclear geology; Pretoria, South Africa (23 Nov 1983).

Published in summary form only.

30016 **(PNL—4980-Exec.Summ.) Guidelines for selecting codes for ground-water transport modeling of low-level waste burial sites. Executive summary.** Simmons, C.S.; Cole, C.R. (Pacific Northwest Labs., Richland, WA (USA)). May 1985. Contract AC06-76RL01830. 47p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85013177.

This document was written to provide guidance to managers and site operators on how ground-water transport codes should be selected for assessing burial site performance. There is a need for a formal approach to selecting appropriate codes from the multitude of potentially useful ground-water transport codes that are currently available. Code selection is a problem that requires more than merely considering mathematical equation-solving methods. These guidelines are very general and flexible and are also meant for developing systems simulation models to be used to assess the environmental safety of low-level waste burial facilities. Code selection is only a single aspect of the overall objective of developing a systems simulation model for a burial site. The guidance given here is mainly directed toward applications-oriented users, but managers and site operators need to be familiar with this information to direct the development of scientifically credible and defensible transport assessment models. Some specific advice for managers and site operators on how to direct a modeling exercise is based on the following five steps: identify specific questions and study objectives; establish costs and schedules for achieving answers; enlist the aid of professional model applications group; decide on approach with applications group and guide code selection; and facilitate the availability of site-specific data. These five steps for managers/site operators are discussed in detail following an explanation of the nine systems model development steps, which are presented first to clarify what code selection entails.

30017 **(RHO-BW-ST—70P) Groundwater travel time uncertainty analysis. Sensitivity of results to model geometry, and correlations and cross correlations among input parameters.** Clifton, P.M. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Mar 1985. Contract AC06-77RL01030. 78p. NTIS, PC A05/MF A01; GPO Dep. File Number DE85013499.

This study examines the sensitivity of the travel time distribution predicted by a reference case model to (1) scale of representation of the model parameters, (2) size of the model domain, (3) correlation range of log-transmissivity, and (4) cross correlations between transmissivity and effective thickness. The basis for the reference model is the preliminary stochastic travel time model previously documented by the Basalt Waste Isolation Project. Results of this study show the following. The variability of the predicted travel times can be adequately represented when the ratio between the size of the zones used to represent the model parameters and the log-transmissivity correlation range is less than about one-fifth. The size of the model domain and the types of boundary conditions can have a strong impact on the distribution of travel times. Longer log-transmissivity correlation ranges cause larger variability in the predicted travel times. Positive cross correlation between transmissivity and effective thickness causes a decrease in the travel time variability. These results demonstrate the need for a sound conceptual model prior to conducting a stochastic travel time analysis.

30018 **(RISO-M—2435) New stack effluent monitoring system at the Risoe Hot Cell plant.** Boetter-Jensen, L.; Hedemann Jensen, P.; Lauridsen, B. (Risoe National Lab., Roskilde (Denmark)). Jun 1984. 50p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85701233.

Also available from Risoe Library, DK-4000 Roskilde, Denmark.

This report describes a new stack effluent monitoring system that has been installed at the Hot Cell facility. It is an integrating iodine/particulate system consisting of a γ-shielded flow house in which a continous air sample from the ventilation channel is sucked through coal and glass filter papers. Activity is accumulated on the filter papers and a thin plastic scintillator detects the β-radiation from the trapped iodine or particulate activity. The stack effluent monitoring system has a two-step regulating function as applied to the ventilation system, first switching it to a recirculating mode, and finally to building-seal after given releases of ^{131}I. The collection efficiency for iodine in form of elementary iodine (I_2) and methyliodide (CH_3I) has been determined experimentally. The unwanted response from a noble gas release has also been determined from experiments. The noble gas response was determined from puff releases of the nuclide ^{41}Ar in the concrete cells. It is concluded that the iodine/particulate system is extremely sensitive and that it can easily detect iodine or particulate releases as low as a few MBq. A gamma monitor placed in connection with the iodine/particulate system detects Xe/Kr-releases as low as a few tens of MBq per second.

30019 **(SAND—84-0996) Benchmarking NNWSI flow and transport codes: COVE 1 results.** Hayden, N.K. (Sandia National Labs., Albuquerque, NM (USA)). Jun 1985. Contract AC04-76DP00789. 113p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE85012245.

The code verification (COVE) activity of the Nevada Nuclear Waste Storage Investigations (NNWSI) Project is the first step in certification of flow and transport codes used for NNWSI performance assessments of a geologic repository for disposing of high-level radioactive wastes. The goals of the COVE activity are (1) to demonstrate and compare the numerical accuracy and sensitivity of certain codes, (2) to identify and resolve problems in running typical NNWSI performance assessment calculations, and (3) to evaluate computer requirements for running the codes. This report describes the work done for COVE 1, the first step in benchmarking some of the codes. Isothermal calculations for the COVE 1 benchmarking have been completed using the hydrologic flow codes SAGUARO, TRUST, and GWVIP; the radionuclide transport codes FEMTRAN and TRUMP; and the coupled flow and transport code TRACR3D. This report presents the results of three cases of the benchmarking problem solved for COVE 1, a comparison of the results, questions raised regarding sensitivities to modeling techniques, and conclusions drawn regarding the status and numerical sensitivities of the codes. 30 refs.

30020 **(SKBF-KBS-TR—83-67, pp 3.1-3.14) Note on the impact of transverse dispersion and immediately dissolved radionuclides.** Rasmuson, A.; Neretnieks, J. (Royal Inst. of Technology. Dept. of Chemical Engineering). May 1983. NTIS (US Sales Only), PC A05/MF A01. File Number DE85780814.

In Some notes in connection with the studies of final disposal of spent fuel. Pt. 2.

The leach rate of highly soluble species such as iodine has been estimated using a tank reactor model. The species are assumed to dissolve in the stagnant pore water (a few thousand liters) in the backfill and to be carried away by the equivalent flowrate in the bedrock (less than 1 liter of water per canister and year). The resulting time constant indicates that half of the species will be leached in a few thousand years. When a single canister is leached the axial and transverse dispersion will dilute the species in time and space. Sample calculations show that for iodine the concentration 100 m downstream from the canister will be diluted by transverse dispersion to a considerable extent. In the calculated example a factor 1000 was obtained. Axial dispersion is of no importance as the leach time (> 1000 yrs) is much longer than the travel time.

30021 **Recent radiochemistry observations at the Riverton and Maybell tailings piles.** Smith, A.R.; Moed, B.A. (Lawrence Berkeley Lab., Univ. of California, Berkeley, CA). pp 205-221 of Uranium Mill Tailings Management. Nelson, J.D. Fort Collins, CO; Colorado State Univ. (1982). (CONF-821209—).

From 5. annual symposium on uranium mill tailings management; Ft. Collins, CO, USA (9 Dec 1982).

Preliminary results are presented from the radiochemistry effort of the Lawrence Berkeley Laboratory integrated study of the inactive uranium mill tailings sites at Riverton, Wyoming and Maybell, Colorado. These results were obtained primarily by use of Y-ray spectrometric techniques, and included both field and laboratory application of NaI(T1) crystal and Ge-semiconductor detector systems. Current interpretation of this evidence indicates there has been downward migration of uranium within the tailings column since its emplacement, and upward movement of several radionuclides from the tailings into the overlying cover material. The mechanisms responsible for these migrations are believed to involve fluid transport, and are further believed to be active at the present time.

0540 Health And Safety

REFER ALSO TO CITATION(S) 29900, 29912, 31738, 32310, 32334

30022 **(AERE-R—11426) Investigation of the liability of surface contamination arising from plutonium containing solutions.** Wilkins, J.D.; Wisbey, S.J. (UKAEA Atomic Energy Research Establishment, Harwell. Chemistry Div.). Sep 1984. 39p. HMSO, London, price Pound 5.00.

The mechanism of contamination from plutonium containing solutions has been studied using ^{238}Pu as a tracer. A double-contamination technique has been used to measure the lability of surface-adsorbed contamination, arising from both plutonium 'polymer', and ionic plutonium solutions. The effect of ageing the contamination solutions, and of changing the contact times has been studied. The results have been interpreted using a model similar to that used for adsorption of organic polymers onto surfaces.

30023 **(BNL—36390-Rev.) Risk comparisons for the transportation of spent fuel from nuclear reactors.** Hull, A.P.; Lessard, E.T. (Brookhaven National Lab., Upton, NY (USA)). Apr 1985. Contract AC02-76CH00016. 9p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85012509.

In summary, on the basis of calculated estimates, tests and accident statistics, the transport of spent nuclear fuel by whatever means has been shown to represent an infinitesimally small risk to the public, wherever they may be located enroute. This conclusion is based on three points (1) the probability of an accident involving spent fuel is small, (2) the probability that this hypothetical accident releases radioactive materials is even smaller and (3) the public-health consequences of such a release are trivial. It hardly seems to warrant the extensive assessment that it has received. If the risk to the public is of concern, this attention and analysis might have been more profitably spent on the improvement of the safety of the transport of a wide variety of other hazardous substances, which at present are given little if any prior scrutiny.

30024 **(DOE/OR/20722—27-Vol.1) Phase II remedial action at the former Middlesex Sampling Plant site and associated properties. Final report. Volume 1.** (Bechtel National, Inc., Oak Ridge, TN (USA). Advanced Technology Div.). Apr 1985. Contract AC05-81OR20722. 113p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE85009915.

The former Middlesex Sampling Plant (MSP) and several adjacent and vicinity properties in Middlesex and Piscataway, New Jersey were designated in 1976 for remedial action under the Formerly Utilized Sites Remedial Action Program (FUSRAP). During the period 1943-55 uranium and thorium ores and concentrates were processed at the plant. Consequently, the plant site and several nearby properties were contaminated with radioactive residues. Phase I work comprised the construction of an impervious asphalt storage pad and drainage system at the former MSP site as well as decontamination of two properties adjacent to the site and three properties in the vicinity. Phase II involved cleanup of low-level radioactive waste that had migrated onto other properties adjacent to the site, the construction of an extension to the waste storage pad, and the installation there of a treatment system for rain runoff. All parcels were cleaned to the remedial action criterion level of 5 pCi/g radium-226 plus background specified by DOE. The effectiveness of the remedial action was corroborated by verification soil sampling, near-surface gamma measurement, and exposure rate measurement. In a subsequent phase or phases, the wastes stored at the site will be removed for permanent disposal and the entire property decontaminated and decommissioned for unrestricted use.

30025 **(DOE/OR/20722—27-Vol.3) Phase II remedial action at the former Middlesex Sampling Plant and associated properties. Final report. Volume 3 .** (Bechtel National, Inc., Oak Ridge, TN (USA). Advanced Technology Div.). Apr 1985. Contract AC05-81OR20722. 187p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE85009917.

Volume 3 contains two appendices: calibration of in situ gamma measurements, and measurements of radiation levels and radium-226 concentrations following remedial action.

30026 **(GAT-A—258) Nuclear criticality safety basics for personnel working with nuclear fissionable materials. Phase I.** Vausher, A.L. (Goodyear Atomic Corp., Piketon, OH (USA)). Oct 1984. Contract AC05-76OR00001. 64p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85012815.

DOE order 5480.1A, Chapter V, "Safety of Nuclear Facilities," establishes safety procedures and requirements for DOE nuclear facilities. The "Nuclear Criticality Safety Basic Program - Phase I" is documented in this report. The revised program has been developed to clearly illustrate the concept of nuclear safety and to help the individual employee incorporate safe behavior in his daily work performance. Because of this, the subject of safety has been approached through its three fundamentals: scientific basis, engineering criteria, and administrative controls. Only basics of these three elements were presented. 5 refs.

30027 **(GAT-T—3297) Upgrading auxiliary facility outleakage and combustion detection. Final project report.** Sandman, R.R. (Goodyear Atomic Corp., Piketon, OH (USA)). 20 Dec 1984. Contract AC05-76OR00001. 11p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85012796.

A new GAT preventive maintenance method, IMG-104, patterned after a similar successful procedure in use at the Oak Ridge Gaseous Diffusion Plant (ORGDP), was issued 2/3/84 to improve the performance of the specially modified Pyrotronics HF/F_2 detectors used in the X-342-A HF vaporizer bay and X-344-C HF storage facilities. Detector thermal protection was added/improved to increase cold-weather sensitivity and reduce moisture absorption by the detectors' dibutylamine reagent. Other moisture problems previously experienced by the X-342-A feed vaporization facility UF_6 outleakage/combustion unmodified detectors were eliminated following replacement of the twelve "open" steam chests with two totally-enclosed autoclaves, and installation of a new out-leakage/combustion detection system. Practical alternate methods of detecting UF_6 outleakage and combustion by-products are discussed, as is substitution of the reagent used in the HF/F_2 detectors; however, no changes were recommended.

30028 (Juel—1950) **Analysis of the risk assessment of a waste repository for radioactive waste from the decommissioning of nuclear power plants.** Weil, L. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorentwicklung). Sep 1984. 167p. (In German). NTIS (US Sales Only), PC A08/MF A01. File Number DE85751650.

A review of decommissioning experiences and concepts is presented. The radioactive inventory of LWR of modern design at final shutdown is estimated on the basis of activation analysis and empirical data on contamination. In combination with existing types of waste packages and deposition techniques these results allow a prediction of the necessary repository volume for the decommissioning wastes in the Federal Republic of Germany. The essential element of this investigation is the development of a model for the quantitative analysis of the accident 'water intrusion' in the repository. Based on the fundamental chemical and physical processes governing nuclide migration a transport equation is obtained which can be restricted to one dimension due to the thickness and the low permeability of the geological layers above the repository. The radiological consequences are evaluated. The long-lived activation product Ni-59 turns out to be critical radionuclide. Despite a number of conservatisms in the model the evaluated doses are acceptable. The results clearly support the long term safety of the 'Konrad' mine as a low-level waste repository.

30029 (NIRS-M—41, pp 285-297) **Tritium exposure and health physics at Japan Atomic Energy Research Institute. Eighteen years of tritium exposure experiences.** Akaishi, Jun (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Mar 1982. NTIS (US Sales Only), PC A15/MF A01. File Number DE85781031. (CONF-811082—).

From Workshop on tritium radiobiology and health physics; Chiba, Japan (1 Oct 1981).

The research activity at the Tokai Research Establishment, JAERI, was started in 1958. Among many facilities at the Tokai Research Establishment, the following facilities are related to tritium exposure: tritium production laboratory, heavy water reactors JRR-2 and JRR-3, van de Graaff accelerator, and waste treatment plant. Among about 1500 radiation workers, about 200 are those handling tritium or working in tritium atmosphere. The production of tritium for nuclear fusion research and the handling of tritium in various facilities are reported. The chemical form of the handled tritium is tritiated water or tritium gas. For monitoring the work places, air flow type ionization chambers, cold trap method and adsorption method have been used. For the protection of the workers, half-face masks and the suits with full-face masks have been used. The individual routine or special monitoring of internal contamination has been carried out. Tritiated water and tritium gas are the foremost contaminative substances. However, the beta energy of tritium is very low, and the organs irradiated by tritium beta radiation are practically limited to soft tissues. Moreover, most of the tritium absorbed in bodies is eliminated fairly rapidly from the bodies, therefore the risk of tritium exposure is not very high.

30030 (NUREG—1127) **Radiation protection training at uranium hexafluoride and fuel fabrication plants.** Brodsky, A.; Soong, A.L.; Bell, J. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Radiation Programs and Earth Sciences). May 1985. 31p. NTIS, PC A03/MF A01 - GPO. File Number TI85901534.

This report provides general information and references useful for establishing or operating radiation safety training programs in plants that manufacture nuclear fuels, or process uranium compounds that are used in the manufacture of nuclear fuels. In addition to a brief summary of the principles of effective management of radiation safety training, the report also contains an appendix that provides a comprehensive checklist of scientific, safety, and management topics, from which appropriate topics may be selected in preparing training outlines for various job categories or tasks pertaining to the uranium nuclear fuels industry. The report is designed for use by radiation safety training professionals who have the experience to utilize the report to not only select the appropriate topics, but also to tailor the specific details and depth of coverage of each training session to match both employee and management needs of a particular industrial operation. 26 refs., 3 tabs.

30031 (NUREG/CR—4203) **Calculational method for determining biological dose rates from irradiated research reactor fuel.** Schnitzler, B.G. (EG and G Idaho, Inc., Idaho Falls (USA)). Apr 1985. Contract AC07-76ID01570. 59p. (EGG—2383). NTIS, PC E05/MF A01 - GPO. File Number TI85012601.

Includes 1 sheet of 48x reduction microfiche.

This report describes a calculational method for the determination of biological dose rate from irradiated research reactor fuels. The calculational method is implemented in a computer program for quick and convenient assessment of multigroup gamma and beta dose rates resulting from an arbitrary (user-supplied) irradiation history. The FUELDR program calculates dose rates at a fixed dose point using built-in fission product impulse source functions and precalculated gamma and beta transport factors. The fixed dose point is located on the axial mid-plane at a distance of 3 ft (91.44 cm) from the fuel element. Transport factors are included for sixteen unique ^{235}U fuel types in use at thirteen nonpower reactor facilities. 16 refs., 12 tabs.

30032 **The status of the uranium mill tailings remedial actions project (UMTRAP).** Matthews, M.L. (US DOE, Uranium Mill Tailings Remedial Actions Project Office, Albuquerque, NM). pp 3-10 of Uranium Mill Tailings Management. Nelson, J.D. Fort Collins, CO; Colorado State Univ., (1982). (CONF-821209—).

From 5. annual symposium on uranium mill tailings management; Ft. Collins, CO, USA (9 Dec 1982).

In 1978, Congress enacted Public Law 95-604, the "Uranium Mill Tailings Radiation Control Act of 1978." The Act authorizes the Department of Energy to stabilize and control the tailings at designated inactive uranium mill tailings sites in a safe and environmentally acceptable manner. DOE has established the Uranium Mill Tailings Remedial Actions (UMTRA) Project Office to implement, in cooperation with the affected States, Indian tribes and owners of the sites, remedial actions at the sites. The UMTRA Project Office has initiated efforts to perform remedial actions in accordance with EPA cleanup standards.

0550 Regulations

REFER ALSO TO CITATION(S) 29887, 29890, 30957

30033 (EUR—9181) **Test of calorimetry for high burn-up plutonium.** Beets, C.; Carchon, R.; Fettweis, P. (Commission of the European Communities, Luxembourg). 1984. 41p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85701521.

In recent times, the interest of applying calorimetry for safeguards purpose is steadily increasing. Calorimetric measurements have been performed on a set of high burn-up (25000 MWd/t) Pu samples, ranging in mass between 60 g and 2.5 kg Pu, distributed as PuO_2 powder embedded in stainless steel containers. The powers produced by these containers ranged between 0.8 W and 36 W. The calorimeter used was the Mound 150 type, and the isotopics and the Am content have been determined earlier by mass spectroscopy, completed with α and γ counting, and were later verified by the same methods. Watts/gram measurements were made on twelve 60 g samples of the same plutonium lot to demonstrate the Pu elemental and isotopic homogeneity, and hence, its suitability for subsequent NDA experiments. These samples were also measured in a stacked way to fill up the mass and wattage gaps between 60 g (0.8W) and 1 kg (14W). Calorimetric assay values, obtained with both isotopic measurements are discussed.

30034 (GAT-NM—119) **Control and accountancy of nuclear materials in a uranium enrichment plant.** Hurt, N.H. (Goodyear Atomic Corp., Piketon, OH (USA)). 21 May 1985. Contract AC05-76OR00001. 8p. (CONF-850556—10). NTIS, PC A02/MF A01; GPO Dep. File Number DE85013128.

From 7. symposium on safeguards and nuclear material management; Liege, Belgium (21 May 1985).

A nuclear material control and accountancy system has been developed by Goodyear Atomic Corporation to meet safeguards and security requirements. It comprises three major elements: physical security, nuclear material control, and nuclear material accounting. This safeguards system is called Dynamic Material Control and Accountancy System (DYMCAS). The system approaches real-time computer control on a transaction-by-transaction basis.

30035 **(IAEA-TECDOC—316) IAEA Safeguards Information System (ISIS). A status report.** (International Atomic Energy Agency, Vienna (Austria)). Oct 1984. 43p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85701283.

Publication of this technical document should serve for better understanding of the technical and functional features of the IAEA Safeguards Information System (ISIS) within the Agency, as well as in the National Systems of accounting for and control of nuclear material. It will also serve as a foundation for further development and improvement of the design and modifications of the Safeguards Information System and its services as a function of Safeguards implementation.

30036 **(Juel-Spez—256) Studies concerning ways of efficiency assessment of safeguard systems.** Canty, M.J.; Stein, G.; Rezniczek, A. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Programmgruppe Technik und Gesellschaft). May 1984. 49p. (In German). NTIS (US Sales Only), PC A03/MF A01. File Number DE85751123.

The problems of assessing the efficiency of safeguards systems are analyzed by the example of the SEAM method. This method turned out to have several weak points, so that the quantification of the efficiency appears to be doubtful. An alternative method is suggested; it makes a qualitative assessment and has the following advantages; the outstanding importance of nuclear materials balancing is pointed out the efficiency of safeguards is best indicated by verifying the presence of nuclear materials instead of an indirect method recording abnormal conditions and the commotation of the term efficiency includes the ideas of partners in the safeguards agreement the logic of the safeguards system can be clearly defined, and it is not based on the analysis of subjective investigations on nuclear materials diversion.

30037 **(LA-UR—85-1649) Integrated nondestructive assay system for a new plutonium scrap recovery facility.** Baker, M. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 5p. (CONF-850556—9). NTIS, PC A02/MF A01; GPO Dep. File Number DE85012710.

From 7. symposium on safeguards and nuclear material management; Liege, Belgium (21 May 1985).

A consortium of laboratories is collaborating with the Savannah River Plant to develop an integrated system of state-of-the-art nondestructive assay (NDA) instrumentation to provide nuclear materials accounting and process control information for a new plutonium scrap recovery facility. Individual microcomputer-based instruments report assay results to an Instrument Control Computer (ICC). The ICC, in turn, is part of a larger computer network that includes computers that perform process control and nuclear materials accounting functions. Integrated system design considerations, integral testing, and individual instrument measurement functions are discussed. 3 refs., 3 figs., 1 tab.

30038 **(LA-UR—85-1683) Feasibility study of plutonium isotopic analysis of resin beads by nondestructive gamma-ray spectroscopy.** Li, T.K. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 5p. (CONF-850556—6). NTIS, PC A02/MF A01; GPO Dep. File Number DE85012717.

From 7. symposium on safeguards and nuclear material management; Liege, Belgium (21 May 1985).

We have initiated a feasibility study on the use of nondestructive low-energy gamma-ray spectroscopy for plutonium isotopic analysis on resin beads. Seven resin bead samples were measured, with each sample containing an average of 9 μg of plutonium; the isotopic compositions of the samples varied over a wide range. The gamma-ray spectroscopy results, obtained from 4-h counting-time measurements, were compared with mass spectrometry results. The average ratios of gamma-ray spectroscopy to mass spectrometry were 1.014 +- 0.025 for ^{238}Pu/^{239}Pu, 0.996 +- 0.018 for ^{240}Pu/^{239}Pu, and 0.980 +- 0.038 for ^{241}Pu/^{239}Pu. The rapid, automated, and accurate nondestructive isotopic analysis of resin beads may be very useful to process technicians and International Atomic Energy Agency inspectors. 3 refs., 1 fig., 3 tabs.

30039 **(LA-UR—85-1684) Simple self-multiplication correction for in-plant use.** Ensslin, N. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 7p. (CONF-850556—7). NTIS, PC A02/MF A01; GPO Dep. File Number DE85012716.

From 7. symposium on safeguards and nuclear material management; Liege, Belgium (21 May 1985).

An improved self-multiplication correction has been derived with the help of an equation recently published by K. Boehnel. The simple correction is suitable for use with existing neutron coincidence counters if a hand calculator or minicomputer is available. Good results are obtained for in-plant materials when the contribution of neutrons from (α,n) reactions can be calculated. 17 refs.

30040 **(LA-UR—85-1685) Simulated physical inventory verification exercise at a mixed-oxide fuel fabrication facility.** Reilly, D.; Augustson, R. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 7p. (CONF-850556—8). NTIS, PC A02/MF A01; GPO Dep. File Number DE85012715.

From 7. symposium on safeguards and nuclear material management; Liege, Belgium (21 May 1985).

A physical inventory verification (PIV) was simulated at a mixed-oxide fuel fabrication facility. Safeguards inspectors from the International Atomic Energy Agency (IAEA) conducted the PIV exercise to test inspection procedures under "realistic but relaxed" conditions. Nondestructive assay instrumentation was used to verify the plutonium content of samples covering the range of material types from input powders to final fuel assemblies. This paper describes the activities included in the exercise and discusses the results obtained. 5 refs., 1 fig., 6 tabs.

30041 **(LA-UR—85-1705) Effect of pulsed-column-inventory uncertainty on dynamic materials accounting.** Ostenak, C.A. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 15p. (CONF-8505139—3). NTIS, PC A02/MF A01; GPO Dep. File Number DE85012714.

From 9. annual actinide separations workshop; Richland, WA, USA (22 May 1985).

Reprocessing plants worldwide use the Purex solvent-extraction process and pulsed-column contactors to separate and purify uranium and plutonium from spent nuclear fuels. The importance of contactor in-process inventory to dynamic materials accounting in reprocessing plants is illustrated using the Allied-General Nuclear Services Plutonium Purification Process (PPP) of the now decommissioned Barnwell Nuclear Fuels Plant. This study shows that (1) good estimates of column inventory are essential for detecting short-term losses of in-process materials, but that (2) input-output (transfer) measurement correlations limit the accounting sensitivity for longer accounting periods ($\geqq$ 1 wk for the PPP). 6 refs., 2 figs., 3 tabs.

30042 **(NUREG—0525-Rev.10) Safeguards Summary Event List (SSEL). Pre-NRC through December 31, 1984. Revision 10.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards). May 1985. 57p. NTIS, PC A04/MF A01 - GPO. File Number TI85901517.

The Safeguards Summary Event List (SSEL) provides brief summaries of several hundred safeguards-related events involving nuclear material or facilities regulated by the US Nuclear Regulatory Commission (NRC). Events are described under the categories of bomb-related, intrusion, missing and/or allegedly stolen, transportation, tampering/vandalism, arson, firearms, radiological sabotage, non-radiological sabotage and miscellaneous. The information contained in the event descriptions in derived primarily from official NRC reporting channels.

30043 (PNL-SA—12710) **Design features for enhancing international safeguards of AFR dry storage for spent LWR fuel.** Roberts, F.P.; Harms, N.L. (Pacific Northwest Labs., Richland, WA (USA)). May 1985. Contract AC06-76RL01830. 8p. (CONF-850556—3). NTIS, PC A02/MF A01 - GPO. File Number TI85012446.

From 7. symposium on safeguards and nuclear material management; Liege, Belgium (21 May 1985).

The Pacific Northwest Laboratory has performed a study for the Nuclear Regulatory Commission to identify and analyze design features that can facilitate the implementation of IAEA safeguards at facilities for dry storage of light water reactor spent fuels. Specific design features are identified that can enhance nuclear material flow and inventory verification. These are assessed from the viewpoint of safeguards effectiveness and possible impacts on the IAEA and the operator of the AFR facility. 11 refs., 3 figs., 2 tabs.

30044 (RFP—3780) **Measurement control for plutonium isotopic measurements using gamma-ray spectrometry.** Fleissner, J.G. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 10 May 1985. Contract AC04-76DP03533. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85013394.

A measurement control (MC) program should be an integral part of every nondestructive assay measurement system used for the assay of special nuclear materials. This report describes an MC program for plutonium isotopic composition measurements using high-resolution gamma-ray spectroscopy. This MC program emphasizes the standardization of data collection procedures along with the implementation of internal and external measurement control checks to provide the requisite measurement quality assurance. This report also describes the implementation of the MC program in the isotopic analysis code GRPAUT. Recommendations are given concerning the importance and frequency of the various MC checks in order to ensure a successful implementation of the MC procedures for the user's application.

30045 (UCRL—15664) **Inspection guide for vulnerability analysis of nuclear sites against outsider threats.** Harris, L. (Science Applications International Corp., La Jolla, CA (USA)). 17 Apr 1984. Contract W-7405-ENG-48. 29p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85012584.

Issuance of the DOE generic threat guidance has resulted in a need for safeguards and security managers to plan and implement measures which provide protection against a range of potential threats. A necessary tool for those who plan and implement such protective measures, as well as those who inspect and evaluate these activities, is a "yardstick" to measure how well the overall system provides protection against these threats. This guide presents a systematic, common-sense, inspection method, based on vulnerability analysis, for evaluating the effectiveness of security at DOE nuclear sites against outsider threats. Application of an effectiveness evaluation method is useful, perhaps essential, for determining if the balance or mix among a site's security measures which provide access control, intrusion detection, access delay, alarm assessment, communication, protective force response, etc. is appropriate. This guide tells how a vulnerability inspection can be performed at a DOE nuclear site by two or three inspectors during a four- or five-day period. At most sites, more personnel and more time can be used productively when available. The evaluation also benefits when protective force exercises are performed as part of the inspection. The guide contains sections describing the inspection method and inspection planning. 6 refs., 6 tables.

06 Processing

REFER ALSO TO CITATION(S) 33056

07 ISOTOPE AND RADIATION SOURCE TECHNOLOGY

0701 Physical Isotope Separation

30046 (AECL—7547) **Future trends in heavy water production.** Galley, M.R. (Atomic Energy of Canada Ltd., Sheridan Park, Ontario. CANDU Operations). Oct 1983. 25p. (CONF-830934—2). NTIS (US Sales Only), PC A02/MF A01. File Number DE85701479.

From 4. Pacific Basin nuclear conference; Vancouver, Canada (11 Sep 1983).

World heavy water production has spanned nearly fifty years and, for much of that period, the commodity was often in short supply, but that situation has changed, at least in Canada. There are now adequate reserves of heavy water and sufficient installed production capacity to service Canadian domestic and export demands for the next ten years or beyond. More than 90 percent of the world's inventory of heavy water has been produced by the GS process but this may not be the method that is chosen when the time comes to expand heavy water production again. Other countries, such as India and Argentina, have already chosen ammonia-hydrogen exchange as an alternative technology for part of their domestic production programs. Despite the present surplus of heavy water, research and development of new technologies is very active, particularly in Canada and Japan, because it is recognized that there are still attractive opportunities for future production by processes that are both less expensive and environmentally more acceptable, than either the demonstrated GS process or ammonia-hydrogen alternative. This paper describes the prospects for some of these new processes, contrasts them with the present established methods and assesses the probable impact on the future supply situation.

30047 (IA—1404, pp 219) **Elimination of the image curvature in the MEIRA isotope separator.** Chavet, I.; Melnick, M.; Tsaidi, Y. Jul 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85780940.

Published in summary form only.

In Research laboratories annual report 1983.

30048 (IA—1404, pp 219-220) **Effective aberrations in electromagnetic isotope separators (EMIS).** Chavet, I. (Israel Atomic Energy Commission, Tel Aviv); Camplan, J. (Paris-11 Univ., 91 - Orsay (France). Centre de Spectrometrie Nucleaire et de Spectrometrie de Masse). Jul 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85780940.

Published in summary form only.

In Research laboratories annual report 1983.

30049 (NAC-AR—84-01, pp 209) **Report of the Van de Graaff Group: nuclear analysis. Radioactive impurities in technetium 99m generators.** Hartman, N.; Felix, G. (Tygerberg Hospital, Stellenbosch (South Africa)); Pineda, C.A. (Cape Provincial Administration); Peisach, M. 1984. NTIS (US Sales Only), PC A14/MF A01. File Number DE85780939.

Short note.

In Annual report June 1984. [Council for Scientific and Industrial Research, Faure (South Africa). National Accelerator Center].

30050 (NAC-AR—84-01, pp 243) **Report of the Researh Group. Development of new measuring techniques and maintenance of laboratory standards.** Meyer, B.R.; Steyn, J.; Conard, F.M.P. 1984. NTIS (US Sales Only), PC A14/MF A01. File Number DE85780939.

Short note.

In Annual report June 1984. [Council for Scientific and Industrial Research, Faure (South Africa). National Accelerator Center].

30051 (NAC-AR—84-01, pp 243-245) **Report of the Research Group. Participation in the International Reference System (SIR) of the Bureau International des Poids et Mesures (BIPM).** Meyer, B.R.; Steyn, J.; Conard, F.M.P. 1984. NTIS (US Sales Only), PC A14/MF A01. File Number DE85780939.

Short note.

In Annual report June 1984. [Council for Scientific and Industrial Research, Faure (South Africa). National Accelerator Center].

0702 Radiation Sources

REFER ALSO TO CITATION(S) 31868, 31888

30052 (DEMO—83/4G) **Flow rate measurements in the sewage pipeline of the major area of Athens.** Leontiadis, I.L.; Dimitroulas, C.P. (Democritos Nuclear Research Center, Athens (Greece)). Apr 1983. 33p. (In Greek). NTIS (US Sales Only), PC A03/MF A01. File Number DE85701480.

Data.

Radioisotope techniques for measurement of the flow rate in the sewage central pipeline of the major area of Athens have been used and the eventual correlation of the flow rate to the sewage water level at the pipeline outlet in Keratsini coastal area has been investigated. The estimation of the flow rate by hydraulic calculations based on the sewage water level at the pipeline outlet in Keratsini coastal area was proved to be a not accurate method; this is attributed to the existing conditions at the outlet of the pipe, as well as to the extremely unstable variation rate of the flow rate. The actual relationship between the flow rate and the sewage water level at the outlet of the pipe was investigated and the inaccuracy accounted to the flow rate estimated by this relationship has been defined.

30053 (PNL-SA—12625) **Irradiation of Northwest agricultural products.** Eakin, D.E.; Tingey, G.L. (Pacific Northwest Labs., Richland, WA (USA)). Feb 1985. Contract AC06-76RL01830. 6p. (CONF-850314—67). NTIS, PC A02/MF A01; GPO Dep. File Number DE85012455.

From Waste management '85; Tucson, AZ, USA (24 Mar 1985).

Irradiation of food for disinfestation and preservation is increasing in importance because of increasing restrictions on various chemical treatments. Irradiation treatment is of particular interest in the Northwest because of a growing supply of agricultural products and the need to develop new export markets. Several products have, or could potentially have, significant export markets if stringent insect control procedures are developed and followed. Due to the recognized potential benefits of irradiation, Pacific Northwest Laboratory (PNL) is conducting this program to evaluate the benefits of using irradiation on Northwest agricultural products under the US Department of Energy (DOE) Defense Byproducts Production and Utilization Program. Commodities currently included in the program are cherries, apples, asparagus, spices, hay, and hides.

30054 (SAND—83-6002(1-83)) **Sealed neutron tubes foreword.** Lidin, G.; Massieux, J. Translated from *Vide, les Couches Minces ;* **37**: No. 212, vp(May-Jul 1982). Contract AC04-76DP00789. 126p. NTIS, PC A07/MF A01; 3; GPO Dep. File Number DE85005532. DE85005532

In this issue, we present: in the first three chapters, a summary of current information on neutron tubes, based on our own experience and the bibliography; and a discussion of two important problems affecting neutron tubes; high voltage breakdown along the tube acceleration path; and aging of the tritiated targets because of the natural decay of tritium into helium 3.

0703 Isotopic Power Supplies

REFER ALSO TO CITATION(S) 29992, 31546

30055 (CONF-8411127—1) **Light your runways and taxiways without electricity.** Tompkins, J.A. (Oak Ridge National Lab., TN (USA)). 1984. Contract AC05-84OR21400. 25p. NTIS, PC A02. File Number DE85003060.

From Annual conference of the IES aviation committee; Charleston, SC, USA (13 Nov 1984).

Lights using krypton 85 were fabricated and tested as airfield-threshold markers, runway edge markers, and taxiway markers. Efforts were then turned to tritium, and the ORNL program was directed toward improvement in light output and light source design. Acquisition distances of over 4 miles were achieved by a combination of tube design, phosphor and coating techniques, quality assurance, and new tritium loading techniques. Field tests have been conducted, a rigorous safety testing and quality control program has been instituted. The dose received when light fixture breaks is analyzed. A cost breakdown is made. (DLC)

30056 (MLM—3250(OP)) **Forming of metal components for radioisotope heat sources.** Johnson, E.W. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 1984. Contract AC04-76DP00053. 22p. (CONF-840113—11). NTIS MF A01; 2; GPO Dep. File Number DE85011281.

From Symposium on space nuclear power systems; Albuquerque, NM, USA (10 Jan 1984).

Flight-quality iridium components can be fabricated from iridium alloys by modifying standard production processes. A large quantity of metrological and NDE data support the quality of these devices, which, in turn, justify their use in containing plutonium fuel for space system applications.

08 HYDROGEN

0801 Production

REFER ALSO TO CITATION(S) 30198

30057 (INIS-mf—9297) **Catalysis of photochemical hydrogen production by metal dithiolenes in aqueous organic solvents.** Zeug, N. (Dortmund Univ. (Germany, F.R.). Abt. Chemie). 27 May 1983. 213p. (In German). NTIS (US Sales Only), PC A10/MF A01. File Number DE85780929.

Photolysis(lambda>=248 nm) of zinc ditetrabutylammonium-bis(cis-1,2-dicyano-1,2-dithiol-ethylene) in mixtures of water with 2,5-dihydrofuran (2,5-DHF) or tetrahydroguran (THF) gives rise to catalytic production of hydrogen. The mechanisms of this process were studied here. The photochemical and thermal properties of zinc dithiolene were studied along with the analogous cadmium and mercury complexes. It could be shown that zinc dithiolene is in fact only the precursor to the actual catalyst which has been identified elsewhere as zinc sulphide. (orig./GG).

30058 **Interfacing the tandem mirror fusion reactor to a hydrogen thermochemical plant.** Hoffman, M.A.; Rowe, D.S. (Lawrence Livermore National Laboratory, Livermore, California). *Nuclear Technology/Fusion;* **6**: No. 2 PT. 1, 288-304(Sep 1984).

Using energy from a fusion reactor to produce such synfuels as hydrogen is a challenging goal because of the special thermal requirements imposed on the blanket design. The interfacing of the tandem mirror reactor to the General Atomic thermochemical process (TCP) for hydrogen production considering two types of interfacing approaches is investigated. The first uses electrical energy to joule heat a high-temperature part of the TCP and can have an overall plant efficiency of about 30 to 36%. The second approach uses hightemperature thermal energy to heat the hightemperature part of the TCP and has an overall plant efficiency of 43%. The trade-off between these two approaches involves consideration of overall plant efficiency versus the feasibility of developing a costeffective, high-temperature blanket and heat transport system for long lifetime and high reliability.

30059 **Catalyzed photodissociation of water.** Somorjai, G.A.; Hendewerk, M.; Turner, J.E. (Lawrence Berkeley Lab., CA). *Catalysis Reviews;* **26**: 683-708(Aug-Dec 1984). Contract AC03-76SF00098.

The photoelectrochemical dissociation of water is reviewed. Two different configurations - the $SrTiO_3$/Pt/KOH semiconductor metal system and the n-type/p-type iron oxide photoelectrochemical diode are considered. Both have been shown to drive the water splitting photochemical reaction without an external potential. The $SrTiO_3$-based system requires illumination by light in the near-UV region (H Nu ≧ 3.1 eV), while the iron oxide system can operate with light in the visible region (h Nu ≧ 2.3 eV). The discussion of these two systems for water dissociation demonstrates the accomplishments and difficulties of research in this field of inorganic photosynthesis. 7 references, 21 figures, 1 table.

0802 Storage

REFER ALSO TO CITATION(S) 31050

30060 **Electrochemical investigation of hydrogen storage in metal hydrides.** Luedecke, C.M.; Deublein, G.; Huggins, R.A. (Stanford Univ., CA). *Journal of the Electrochemical Society;* **132**: 52-56(Jan 1985).

One of the problems regarding the use of hydrogen as an energy carrier is related to storage. One approach for a solution is related to the use of solid metal hydrides. Many studies regarding the formation of metal hydrides have included the conduction of absorption experiments in which hydrogen from the gas phase reacts with solid alloys. However, electrochemical methods provide another approach for the study of metal hydrides. Thus, measurements can be conducted under isothermal conditions by applying an electrical potential, rather than changing the pressure and/or the temperature. Certain difficulties related to a use of aqueous electrolytes can be avoided by using nonaqueous electrolytes. In the present investigation, NaH dissolved in a low temperature molten salt is used as the electrolyte. The hydrogen transmitting species in this case are not H(+) ions, but H(-) ions. A new theoretical approach is also discussed and applied, together with the considered experimental method, to three systems. These systems include Mg-Ni-H, Mg-Cu-H, and Mg-Al-H. 29 references.

0806 Industrial And Commercial Use

30061 (NP—5770191, pp 4.1-4.15) **Hydrogen in future energy supplies.** Vigeholm, B. Jan 1984. (In Danish). NTIS (US Sales Only), PC A16/MF A01. File Number DE85770191.

EFP-81.

In Technological development and its impact on the future energy system. Appendix 1. Evaluation commissioned by the Danish Ministry of Energy.

Hydrogen is probably the best future energy carrier, effectively stored, transferred and converted into the required applied form. Hydrogen production based at present on the expensive steam reforming processes has to be developed by other methods, if hydrogen is to play essential role in the future energy supply. On the other hand the environmental aspects are very much in favor of this very clean energy source.

0808 Properties

REFER ALSO TO CITATION(S) 30076, 31324

09 OTHER SYNTHETIC AND NATURAL FUELS

0901 Hydrocarbon Fuels

REFER ALSO TO CITATION(S) 30082, 30298, 31374, 31675, 31821

30062 **(AFEE—66-330207) Methane fermentation of agricultural residues. Utilization in farming.** Beaumond, N. (Ecole Nationale Veterinaire de Lyon, 69 (France)). 1980. 51p. (In French). NTIS (US Sales Only), PC A04. File Number DE85751225.

The application of methane fermentation to the conversion of agricultural residues into energy is studied, with emphasis on biogas technology. The advantages of this process in farming and specially in bigger farms are described. They are as follows: diminution of environmental pollution; use of fermentation residues as fertilizers; as animal feeds; sanitary utility of methane fermentation for pathogen destruction.

30063 **(BNL—36366) Flash hydropyrolysis and methanolysis of biomass with hydrogen and methane.** Steinberg, M. (Brookhaven National Lab., Upton, NY (USA)). Apr 1985. Contract AC02-76CH00016. 28p. (CONF-850512—2). NTIS, PC A03/MF A01; GPO Dep. File Number DE85013291.

From Beijing international symposium on hydrogen systems; Beijing, China (7 May 1985).

The process chemistry of the flash pyrolysis of biomass (wood) with the reactive gases, H_2 and CH_4 and with the non-reactive gases He and N_2 is being determined in a 1 in. downflow tubular reactor at pressures from 20 to 1000 psi and temperatures from 600 to 1000°C. With hydrogen, flash hydropyrolysis leads to high yields of methane and CO which can be used for SNG and methanol fuel production. With methane, flash methanolysis leads to high yields of ethylene, benzene and CO which can be used for the production of valuable chemical feedstocks and methanol transportation fuel. At reactor conditions of 50 psi and 1000°C and approximately 1 sec residence time, the yields based on pine wood carbon conversion are up to 30% for ethylene, 25% for benzene, and 45% for CO, indicating that over 90% of the carbon in pine is converted to valuable products. Pine wood produces higher yields of hydrocarbon products than Douglas fir wood; the yield of ethylene is 2.3 times higher with methane than with helium or nitrogen, and for pine, the ratio is 7.5 times higher. The mechanism appears to be a free radical reaction between CH_4 and the pyrolyzed wood. There appears to be no net production or consumption of methane. A preliminary process design and analysis indicates an economically competitive system for the production of ethylene, benzene and methanol based on the methanolysis of wood. 8 refs., 18 figs., 1 tab.

30064 **(DGRST—79-7-1290) Methane production from cellulosic wastes: kinetic studies.** Goma, G.; De La Torre, I.; Maugheri, F.; Yameogo, T. (Delegation Generale a la Recherche Scientifique et Technique (DGRST), 75 - Paris (France)). Sep 1979. 52p. (In French). NTIS (US Sales Only), PC A04/MF A01. File Number DE85751220.

The anaerobic fermentation is studied on lignocellulosic materials and sucrose as substrate. With the lignocellulosic material cellulolysis is rate limiting. The reducing sugar concentration in the fermentation broth is less than 15 mgl^{-1}. With rumen bacteria, 50% of the initial polyoside are used and 12% of the lignin is solubilized. With sucrose studies on the kinetic behaviour of the mixed population responsible of the acidogenesis step permite to find the optimal temperature (40°C) feed substrate concentration (50 gl^{-1}) residence time (60 hours) and pH (5,5 - 6). The better technology is a plug flow fermentor with cell recycling. Modeling of the behaviour of this reactor was performed. The use of this reactor for the selection of acido resistant bacteria is discussed. For methanogenesis, in continuous culture, the ideal technology seems to be an association of two reactors. In the first step, a plug flow reactor must be used for acidogenesis, and in the second step a well mixed reactor permit the conversion of organic acids in methane.

30065 (DOE/ER/10345—T1) Mechanistic studies of carbon monoxide reduction. Final technical report. Geoffroy, G.L. (Pennsylvania State Univ., University Park (USA). Dept. of Chemistry). 1984. Contract AC02-79ER10345. 20p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004305.

The major aim of nearly all synthesis gas research involves the development of more active and selective catalysts. One way to approach catalyst development is through mechanistic studies whereby an understanding of the mechanistic course of the reaction should allow the design of more efficient catalysts. It is the major aim of this research program to contribute to that mechanistic understanding. Two approaches will be employed in this research. First, certain aspects of the mechanism of the heterogeneous metal surface catalyzed reduction of CO will be probed using transition metal cluster complexes to model the chemistry of metal surfaces. Secondly, we will address various aspects of the mechanism of homogeneous CO reduction by focusing on a few key mechanistic steps, particularly halide-promoted reactions and the formation, stabilization, and reactivity of formyl, acyl, methylene, and ketene ligands. Some exploratory work is also proposed involving studies of the adsorbed state of simple unsaturated molecules on metal surfaces using solid-state ^{13}C NMR spectroscopy, as well as reactions which model non-synthesis gas chemistry of metal surfaces. 39 refs., 7 figs., 1 tab.

30066 (DOE/PC/30228—T10) New catalysts for the indirect liquefaction of coal. First quarterly technical report, August 1-October 31, 1981. Melson, G.A. (Virginia Commonwealth Univ., Richmond (USA). Dept. of Chemistry). 1981. Contract FG22-80PC30228. 4p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85013156.

During the first three months of the second year of support under grant No. FG22-80PC30228 work has concentrated on the evaluation of the catalytic ability of some iron/zeolite catalysts for synthesis gas conversion. The catalysts were prepared from $Fe_3(CO)_{12}$ and the zeolite support 13X by methods previously reported or from $Fe(NO_3)_3$ x 9 H_2O and the support by the incipient wetness technique. All catalysts have been evaluated using a synthesis gas mixture of H_2:CO, 1:1 at 300 psig and at 280° and 300°C with a Chemical Data Systems Series 804 CF-HP microreactor. Effluent gases and liquid products have been analyzed by techniques described in previous reports. Each catalyst was evaluated for a period of 2 to 3 weeks. The catalytic data obtained are presented. 1 tab.

30067 (DOE/PC/50804—9) CO + H_2 reaction over nitrogen-modified iron catalysts. Quarterly technical progress report, October 1, 1984-December 31, 1984. Delgass, W.N. (Purdue Univ., Lafayette, IN (USA). School of Chemical Engineering). 1985. Contract FG22-82PC50804. 25p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85013791.

Preoxidizing a freshly prepared zeta-Fe_2N catalyst resulted in unique Fischer-Tropsch behavior. Characterization of this catalyst by Moessbauer spectroscopy indicated contributions from both zeta-Fe_2N and Fe_3O_4. The kinetic behavior of this preoxidized catalyst revealed a remarkable enhancement in the C_4 and C_5 hydrocarbons as compared to the kinetics over the zeta nitride. Transient kinetic studies by mass spectrometry determined the bulk stoichiometry of a prenitrided catalyst after 12 hours of reaction in 3/1 H_2/CO at 523 K by monitoring the H_2O, NH_3 and CH_4 produced during temperature programmed reduction in H_2. The ϵ-Fe/sub 2.7/N catalyst lost 24% of its nitrogen. The zeta-Fe_2N catalyst lost 15% of its nitrogen. 14 refs., 3 figs., 2 tabs.

30068 (DOE/PC/50810—T10) Promotion effects on the synthesis of higher alcohols. 11th quarterly report, January-March 1985. Goodwin, J.G. Jr.; Chuang, S.C. (Pittsburgh Univ., PA (USA). Dept. of Chemical and Petroleum Engineering). Apr 1985. Contract FG22-82PC50810. 30p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85011001.

In order to gain a better understanding of the mechanism of CO hydrogenation, we have studied Ni/SiO_2 (a methanation catalyst), Ru/SiO_2 (a higher hydrocarbon synthesis catalyst), Rh/SiO_2 (a synthesis catalyst with high selectivity for C_2 oxygenates), and Pd/SiO_2 (a methanol synthesis catalyst) by the addition of probe molecules to CO/H_2 under synthesis conditions. Ethylene, ethanol, and acetaldehyde were utilized as probe molecules in this study. The addition of ethylene can produce hydrocarbon intermediates, and the addition of ethanol and acetaldehyde may lead to oxygen-containing intermediates. These intermediates may be similar to those produced by Fischer-Tropsch (F-T) synthesis. The addition of such probe molecules, however, could have a great effect on the overall product distribution. The possible reactions due to the addition of these probe molecules are summarized in Table I-III. By determining the ability of a catalyst to catalyze these specific reaction steps, the reaction paths for the formation of hydrocarbons and oxygenates on these metal catalysts may be clarified. 49 refs., 1 fig., 9 tabs.

30069 (DOE/R2/05003—T1) Production of a usable energy source by anaerobic digestion of rum waste. Erdman, M.D. (Puerto Rico Univ., San Juan. Center for Energy and Environment Research). 1975. Contract FG42-79R205003. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85012216.

A 10-liter anaerobic fermentor was constructed from plastic (PVC) and glass tubing, stainless steel turnings, steel couplers and valves. The fermentor consisted to two parallel cylinders which were connected at top and bottom. The fermentor system was also equipped with hydraulic agitation, pH measuring, controlling and recording capabilities, temperature recorder, plug or continuous flow fermentation capabilities, sample ports and a wet test gas meter. The fermentor was inoculated with 9.5-liters primary sewage sludge and plug fed 0.5-liter of rum waste daily for 48 days. The pH remained at 6.8 and temperature was 27.9 +- 0.16°C throughout the fermentation. Rum waste, anaerobically fermented at a 10 day hydraulic retention time produced 1.93-liters of biogas at standard conditions/liter of rum waste. The biological oxygen demand of unfermented and fermented rum waste were 35135 and 25000 mg/1, respectively. Total solids level of rum waste influent and effluent were 75992 and 61392 mg/1, respectively. 1 ref., 3 figs., 1 tab.

30070 (DOE/R3/02456—T1) Integrated renewable energy/organic waste recycling system. Final report, July 31, 1982. Hamburg, R.A.; Davenport, S. (Hamburg (Robert A.), Orma, WV (USA)). 1982. Contract FG43-80R302456. 81p. NTIS MF A01; 2; GPO Dep. File Number DE85009329.

Two operating systems for integrated recycling of organic materials are described. The systems include Chinese water-pressure design biogas digesters/solar greenhouses/and algae and aquatic plant ponds-all in passive symbiotic relationships with a minimum of technological sophistication. Economic, Financial and Net Energy Analyses of these systems have been done with concern toward long term environmental effects. A discussion of fish ponds and fuel alcohol production is also included since they offer much potential for expanded integration. 21 tabs.

30071 (DOE/SF/01985—T1) Biogas energy for Hawaiian small farms and homesteads, HI-11. Final report. Weitzenhoff, M.H. (Weitzenhoff (Michael H.), Honolulu, HI (USA)). Feb 1980. Contract FG03-78SF01985. 83p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85012218.

This report contains the results of a US Department of Energy, Appropriate Energy Technology grant for the development and demonstration of a simple, easy-to-operate and high energy yielding anaerobic bioconversion system for Hawaiian small scale hog farms. The system included a flexible material "rubber" digester, gas storage tank, algae pond, wastewater recycling loop, and gas utilization appliances. Ten cubic feet of biogas per 150 pound hog per day was identified as the sustainable yield of biogas using this system under Hawaiian farm conditions at a 15-day retention period without heating or mixing the anaerobic digester. Cost of the system was compared with the economic value of the gas produced and the investment recovery period was found to be 1.16 years. Biogas was used to fuel numerous farm appliances, including nursery infra-red heaters, gas lamps and an internal combustion powered water pump. Digested pig manure was renovated by recycling through an algae pond, after which it was used in biweekly hog housing sanitation washdowns. Finally, the results of the project have been promulgated through informal seminars, workshops, and the publication-distribution of a farmer oriented manual on digester installation and operation. 6 refs., 14 figs., 1 tab.

30072 **(FRNC-TH—1620) Simulations of the kinetics of large wood particle pyrolysis and of material balance of pure oxygen gasification.** Belleville, P. (Universite de Technologie de Compiegne, 60 (France)). Dec 1982. 154p. (In French). NTIS (US Sales Only), PC A08. File Number DE85751351.

The different processes and apparatus involved in gasification of heat transfer problems, of wood pyrolysis kinetics, and of the composition of gasification products are reviewed. The pyrolysis of large wood particles and setting up of a heat transfer model allowing the simulation of wood pyrolysis kinetics are studied experimentally. Results obtained during a series of trials conducted on an oxygen fluidized bed gasification pilot plant are given.

30073 **(FRNC-TH—1898) Methane fermentation of substrate mixtures. Kinetic and microbiological aspects.** Petroff, D. (Ecole Nationale Veterinaire de Lyon, 69 (France)). 1983. 279p. (In French). NTIS (US Sales Only), PC A13/MF A01. File Number DE85751223.

A single-stage digestion study of the mesophilic and thermophilic anaerobic digestion of four mixtures prepared from residual sludge, algae, brewery draff and household refuse, was carried out. Isolation and characterization of methanogenic bacteria that use acetate was performed.

30074 **(FRNC-TH—1969) Biomass thermochemical liquefaction.** Esnouf, C. (Ecole Nationale Superieure de Chimie, 75 - Paris (France)). Apr 1984. 363p. (In French). NTIS (US Sales Only), PC A16/MF A01. File Number DE85751592.

The bulk of research carried out for producing liquid fuels (including engine fuel) through direct thermochemical routes, has been analyzed, except for conventional acid hydrolysis. The more detailed researches have been taken into special consideration, such as the alkaline CO-steam process which has lead to a process Development unit at Albany (USA). The process has been analyzed and we have identified the reasons for its failure. We tried to build a complete chemical reactional mechanism for biomass components under liquefaction conditions, and we found promising tracks for research. (An experimental program has been proposed in a field not yet studied). So we assessed the potentials of liquefaction. In order to test a large range of reactions, at a proper scale, we have developed a 15 liters reactor, which can process 2 Kg wood up to 450°C and 300 bars, and under corrosion conditions occasionally severe. Considering the importance of kinetic parameters, the reactor has been designed to give a very short heating time (15 minutes up to 350°C now, less than 2 minutes with a small alteration), while keeping an easy running and a maximum security.

30075 **Surface science and catalysis.** Somorjai, G.A. (Univ. of California, Berkeley). *Science (Washington, D.C.);* **227**: 902-908(22 Feb 1985). Contract AC03-76SF00098.

During the last 20 years, surface scientists have developed a variety of techniques that make it possible to study, on the molecular level, the structure, composition, and chemical bonding in the surface monolayer. Both single-crystal model catalysts and real catalyst systems that are active in important chemical processes have been investigated by a combination of ultrahigh-vacuum surface science techniques and high-pressure kinetic techniques in an effort to determine the relation between the structure and composition of the surface and the rates of reaction and selectivities. The structure of the atomic surface, a strongly adsorbed overlayer, and the oxidation states of surface atoms are the important molecular features of an active catalyst. As a consequence of modern surface science, the design and preparation of catalysts has developed from an art into a high technology.

30076 **Chemical kinetic modeling of hydrocarbon combustion.** Westbrook, C.K.; Dryer, F.L. (Lawrence Livermore National Lab., CA). *Progress in Energy and Combustion Science;* **10**: No. 1, 1-57(1984).

A review of high-temperature hydrocarbon oxidation in combustion systems discusses the reaction mechanisms for specific fuels - from hydrogen to n-butane - emphasizing the hierarchical structure of the mechanisms for complex fuels in order to develop the concept of a comprehensive mechanism. In relating kinetic models to real combustion systems, the study begins with purely kinetic thermodynamic applications that neglect transport effects such as diffusion of heat and mass (as in shock tubes, detonations, plug flow reactors, and stirred reactors). It then describes laminar flames, the coupling between diffusive transport and chemical kinetics, and applying laminar flame models to practical combustion problems.

0902 Alcohol Fuels

REFER ALSO TO CITATION(S) 31156

30077 **(FRNC-TH—1752) Immobilized yeasts: growth and metabolism, alcohol fermentation.** Navarro, J.M. (Toulouse-3 Univ., 31 (France)). Jun 1980. 128p. (In French). NTIS (US Sales Only), PC A07. File Number DE85751226.

The reaction characteristics of Saccharomyces uvarum immobilized in solid supports are presented. Two types of solid supports are used, porous brick and porous silica. Yeast adsorption and covalent coupling, influence of pore size on adsorption are evaluated. The effects of immobilization on growth and metabolic activity (CO^2 and ethanol production rate) of Saccharomyces uvarum are described.

30078 **(FRNC-TH—1753) Continuous ethanol production with yeasts adsorbed on a solid support.** Ryu, Y.W. (Institut National des Sciences Appliquees (INSA), 31 - Toulouse (France)). Jul 1980. 81p. (In French). NTIS (US Sales Only), PC A04. File Number DE85751227.

Continuous ethanol fermentation is carried out with Saccharomyces Cerevisiae, immobilized on various solid supports, in a tubular reactor and in a gradostat. The five following supports are investigated: biodamine (porous ceramics, wood shavings, PVC, corn cob, silica). The retention capacities of these supports concerning Saccharomyces cerevisiae and the production rate of ethanol are evaluated. The adsorption of Saccharomyces cerevisiae on wood shavings, which seems to be the most efficient support, is particularly studied.

30079 **(FRNC-TH—1871) Alcohol fermentation: study in continuous culture of the effect of temperature and antibiotics in a multi-stage reactor.** De Albuquerque, A.U. (Toulouse-3 Univ., 31 (France)). 1982. 12p. (In French). NTIS (US Sales Only), PC A02/MF A01. File Number DE85751222.

A study in a multi-stage reactor of the continuous fermentation of glucose by Saccharomyces bayanus, was carried out. The following topics were successively described: influence of antibiotics on the yeast ethanol tolerance; effect of temperature; nature of the mechanism of inhibition by ethanol; effect of variation of the glucose load by modifying the flow rate and initial concentration; modelisation of the fermentation kinetics; assessment of the fraction of ethanol produced by non-proliferating cells.

30080 **Over-production of cellulase - screening and selection.** Cuskey, S.M.; Frein, E.M.; Montenecourt, B.S.; Eveleigh, D.E. New Brunswick, NJ; Rutgers University (1982). 11p. Contract AC02-83ER13106.

In order to enhance and facilitate enzymatic hydrolysis of cellulose, a program has been initiated to increase the yields of cellulase, and to obtain enzymes with greater specific activities. An attempt has also been made to obtain enzymes that are less subject to end-product inhibition. Investigations have been concerned with gaining mutants with more effective β-glucosidase and also immobilizing cells in order to effect greater cellulase productivity.

0904 Solid Waste And Wood Fuels

REFER ALSO TO CITATION(S) 30504

30081 **(CR—84-031) Evaluation of HRI facilities at NS Mayport and NAS Jacksonville, Florida - lessons learned report [heat recovery facility]. Final report.** Frounfelker, R.; Belencan, H. (Systech Corp., Xenia, OH (USA)). Jul 1984. 168p. Naval Civil Engineering Lab., Port Hueneme, CA 93043. File Number TI85901463.

The Naval Station (NS) Mayport and Naval Air Station (NAS), Jacksonville, Florida, heat recovery incinerator (HRI) facilities employ two different technological approaches to perform the twofold task of base-generated waste disposal and energy recovery. The NS Mayport HRI utilizes a single 50-ton per day (TPD) field-erected, excess-air, grate incinerator to mass burn the as-received waste. A pit/crane is used to store and retrieve the waste. The NAS Jacksonville HRI utilizes three 24-TPD modular starved-air, refractory hearth incinerators to burn a refuse-derived fuel (RDF) waste. The RDF processing system is located on site, and a live-bottom bin is employed for storage and retrieval of the RDF. The NS Mayport HRI is operational and burns an average of 1.25 tons/hr (TPH) of solid waste 4 to 5 days/wk. The NAS Jacksonville HRI is not operational and has been closed since June 1983. The objective of this report is to evaluate and compare the performance of these two concepts and to make recommendations concerning future applications within the Navy Shore establishment. In addition, the report defines the lessons learned from the design, construction, and operation of these two facilities. To meet these objectives, the feasibility studies, design documents, and operational data from the two HRI facilities were reviewed. Additional information was obtained from site visits and discussions with facility operators and personnel associated with the various phases of these two projects. 25 refs., 28 figs., 16 tabs.

30082 **(ERG-MR—4e) Alternative liquid fuels.** Overend, R.P.; Moo-Young, M.; Robinson, C.W.; Lencki, R. (Energy Research Group, Ottawa (Canada)). Jun 1984. 34p. Energy Research Group, P.O. Box 8500, Ottawa K1G 3H9, Canada. File Number TI85901443.

This report contains 2 papers which were presented at the Energy Research Priority Seminar in Ottawa on August 9, 1983. Both papers address biomass conversion to energy. The first paper discusses the status, economics and net energy of biomass combustion, gasification, syngas, direct liquefaction, anaerobic digestion, and fermentation processes. An extremely large range of technologies is available for biomass conversion, and the available systems cover a large range of scales and technical maturities. Energy balance and economics favor the direct combustion of biomass for process heat and space-conditioning applications. Where the local demand requires conversion to electricity or liquid fuels, the energy and economic penalties are severe and are a barrier to implementation. The second paper compares alternative feedstocks for ethanol and methanol production. The economics of using corn, wood, wastes, sugar cane, and algae are considered.

30083 **(FRNC-TH—1900) Energetic beneficiation of biomass: designing a high-density straw press with oscillating elements.** Drouin, B. (Ecole Nationale Superieure des Arts et Metiers, 75 - Paris (France)). 1981. 2p. (In French). NTIS (US Sales Only), PC A02/MF A01. File Number DE85751224.

The study deals, on the one hand, with the design of a straw press containing heavy components (800 kg) oscillating at high frequency (1 to 2 Hertz), on the other hand, with the description of a special process for maintaining an oscillatory motion and its application to the prototype constructed.

30084 **(PB—85-168839/XAB) Wood residue value at the heating plant - a comparison with oil.** Thoernqvist, T. (Sveriges Lantbruksuniversitet, Uppsala. Institutionen foer Virkeslaera). 1983. 57p. (In Swedish). (REPT—139). NTIS, PC E04/MF E01.

A study was made of those factors that influence a heating plant's ability to pay for wood residues, compared with oil. The information base for the analysis is from the answers obtained from questionaires sent to five heating plants (in Sweden). The analysis is directed towards the additional cost of solid-fuel-fired heating plants as compared to oil firing.

30085 **(SNV-PM—1713) Firing fast fuels on a small scale in densely built areas. Basic document.** Bernegaard, L.; Hindrum, K.; Lindau, L. (Statens Natuurvaardsverk, Solna (Sweden)). Sep 1983. 152p. (In Swedish). NTIS (US Sales Only), PC A08. File Number DE85750842.

The aim of this report is to present the background data of the proposal for general recommendations concerning firing procedures in densely built areas. The use of wood fuel has started to increase again since the small houses have been furnished with stoves as complementary heating equipment. While the use of solid fuels has increased, the complaints about pollution and troubles in respiratory organs to the authorities have increased as well. Firewood is predominant, and chips, pellets and waste fuels have become available, the latter fuel type being inconvenient. The boilers in general have a magazine, they are top fired with a water cooled firing chamber. The combustion temperature seldom exceeds 800 C degrees so that all gases will not be ignited. New furnace designs are being introduced, having inverse combustion and ceramic after-burners. Stoves are being developed to improved insulation and combustion. Low emissions of carbon oxides, particulates and organic substances, e.g. 2 mg tar per MJ can be obtained by suitable designs. When using individual houses, a long-time average value of dilution factor of 8000 can be calculated for the gases at a distance to 40 m. Studies of wood firing in minor settlements show increasing emission of organic substances, even if only 10 percent of energy supply is coming from wood.

30086 **(STEV-SB—83-26) Drying of wood chips for fuel. Full scale tests and dryer designs.** Svensson, L. (Statens Energiverk, Stockholm (Sweden)). Feb 1983. 103p. (In Swedish). (SLU-LBT—126). NTIS (US Sales Only), PC A06. File Number DE85750866.

In this report the possibilities of artificial drying of fuel chips with air, with or without additional heating is illustrated. The report may function as a dimensioning basis then construction dryer set-ups. By drying fuel chips you obtain a number of advantages at the continued handling. These advantages are summarized below: Increased heating value, Reduced fungal growth, Lower dry substance loss at storing, Lower emission of organic compounds at combustion, Less damage on building materials at storing. It is important that the fuel chips are dryed to a low moisture content as soon as possible after chipping. Measurements of the fungal growth show that the longest acceptable time of drying down to 20 percent moisture content, is 15 days. In the project the basic conditions of dimensioning a dryer has been designed. The basic data are: The pressure drop of the air passing over the fuel chips. The water absorption of the air. Degree of vapor saturation of the outgoing air. The effect of additional heating on the drying speed. When drying wood chips with cold air during summer there is good chance of obtaining a positive energy balance. The report also mentions examples of various designs for dryers, and in appendix 1 and 2 two full-scale tests are described.

30087 **Georgia wood energy research and development project.** Bulpitt, W.S.; McGowan, T.F. (Georgia Inst. of Tech., Atlanta). pp 435-441 of Proceedings of industrial wood energy forum '82. Vol. II. Madison, WI; Forest Products Research Society (1983). (CONF-820341—).

From Industrial wood energy forum; Washington, DC, USA (8 Mar 1982).

In 1979 a grant was awarded to the Georgia Office of Energy Resources (OER) by the Biomass Energy Systems Division of the U.S. Department of Energy for the purpose of exploring many issues related to furthering the use of wood energy in an industrial regime, with particular emphasis placed on the use of wood by non-forest products industries. The Engineering Experiment Station at Georgia Tech. was selected as the prime contractor to perform the bulk of the work. This paper will briefly describe the highlights of this program as will the presentation included in the Technical Forum Session at the 1982 6th Industrial Wood Energy Forum.

13 HYDRO ENERGY

30088 (CONF-7907129—, pp 95-108) **Selected bibliography of literature on small-scale hydroelectric.** Master, D.B. (Univ. of California, Los Angeles). May 1980. NTIS, PC A11/MF A01. File Number DE84005144.

From UCLA small-scale hydro resources development western regional workshop; Pomona, CA, USA (30 Jul 1979).

A bibliography on small-scale hydroelectric power development is presented. The bibliography, containing 102 references, is divided into the following sections: engineering and technology; economics and utility interface; regulation, institutional barriers, and government policy; environment; and general.

30089 (NP—5901441) **Renewable energy: hydropower.** (Florida Governor's Energy Office, Tallahassee (USA)). Apr 1985. 20p. NTIS, PC A02/MF A01. File Number DE85901441.

In Florida, hydropower will continue to supply some baseload electrical capacity using existing facilities such as Jim Woodruff Dam. New hydro facilities may meet local needs in some cases, such as in Tallahassee and Leesburg. However, hydropower is not expected to make important contributions to Florida's energy needs largely because of the state's flat topography. The use of hydro for generating peaking electric power is technically and environmentally undesirable in Florida since lakes have minimal storage capacity and water fluctuations have adverse effects on fish and wildlife as well as water quality. Limited potential may exist for small hydro installations to serve local and individual needs at existing dams in Florida. Nationwide, small hydro will be at a disadvantage because it will not have a dependable capacity and will have high capital costs. Small hydro will probably not off set the need to build new power plants for this reason. Advantages of reliability, efficiency, and lack of atmospheric or thermal pollution will continue to make hydropower worthy of consideration. It is possible that small hydro will be able to contribute 8000 MW to the nation's energy picture with minimal impacts on land and water resources. Large hydro projects can contribute 46,000 MW, but with potential major impacts on water resources.

1301 Resources And Availability

30090 (CONF-7907129—, pp 5-8) **General recommendation areas.** May 1980. NTIS, PC A11/MF A01. File Number DE84005144.

From UCLA small-scale hydro resources development western regional workshop; Pomona, CA, USA (30 Jul 1979).

A number of policy-related themes emerged out of the separate working group discussions as well as from the general sessions. These themes constitute major recommendation areas stemming from the workshop. To some extent, these areas reflect issues specific to a topic; in other cases, they cut across topical lines to emphasize a more generic consideration. In either case, they deserve close scrutiny by the spectrum of organizations, individuals, agencies, and other entities associated with various aspects of small-scale hydro development in the West.

30091 (CONF-7907129—, pp 29-30) **Summary of plenary discussion on follow-on activities to the workshop.** May 1980. NTIS, PC A11/MF A01. File Number DE84005144.

From UCLA small-scale hydro resources development western regional workshop; Pomona, CA, USA (30 Jul 1979).

An explicit goal of the UCLA Workshop was to explore and if possible, initiate follow-on activities for promoting small hydro development which would continue the positive momentum built up at the Kellogg West Conference Center. Thus, after the equivalent of about two days worth of very focused, topic-specific discussion in work groups, an open plenary session was held to broach the issue of follow-on. Although there was some overlay in this discussion with the subject matter of various work session, the final output was substantially more diverse. The flow of discussion in this open session did not yield a coherent set of activities and commitments which could be considered to be a follow-on program. Many ideas were suggested, but specific mechanisms were seldom agreed upon as a means to actualize them. Nonetheless, some specific commitments were made and there was a strong sense of interest and concern that is likely to be pursued by individuals through their existing associations with professional and other organizations.

30092 (CONF-7907129—, pp 31-50) **Speakers' remarks.** May 1980. NTIS, PC A11/MF A01. File Number DE84005144.

From UCLA small-scale hydro resources development western regional workshop; Pomona, CA, USA (30 Jul 1979).

The following speakers discussed various aspects of small-scale hydroelectric development: Ronald D. Doctor, Commissioner, California Energy Commission; Wilson Clark, Energy Advisor to the Governor of California; Ellis Armstrong, Commissioner, US Bureau of Reclamation and Chairman, US National Committee of the World Energy Conference; Claire Dedrick, California Utilities Commission; Richard McDonald, Director, Resource Applications Division, US DOE; and Eugene Neblett, Federal Energy Regulatory Commission.

30093 (CONF-7907129—, pp 91-94) **Development of small hydroelectric power in China.** Zhao-Xiang, Tu. (China National Machinery and Equipment Export Corp.). May 1980. NTIS, PC A11/MF A01. File Number DE84005144.

From UCLA small-scale hydro resources development western regional workshop; Pomona, CA, USA (30 Jul 1979).

The development of small hydroelectric power plants in China is discussed. China has abundant water resources. The national potential of these resources may be about 580,000 MW, of which approximately 150,000 MW are to be generated by medium and small rivers. Approximately 50% of the countries in China are reported to have hydroelectric resources with the potential capacity of 10,000 kW power supply or even higher. Therefore, long-term development of China's hydroelectric resources is one of the most effective measures in the course of China's modernization.

30094 (CONF-7907129—, pp 123-140) **Need for hydroelectric resource development in the West.** Armstrong, E.L. May 1980. NTIS, PC A11/MF A01. File Number DE84005144.

From UCLA small-scale hydro resources development western regional workshop; Pomona, CA, USA (30 Jul 1979).

The necessity for the development of the hydroelectric resources in the Western US is discussed. These resources must be developed because of the well-known fact that we are running out of energy. It is necessary that the energy industries and government agencies change from an era of competition and of adversary stances between industry and government to an era of complementation and cooperation if the needs of society are to be meet.

30095 (TVA/PUB—84/21a, pp 366-375) **Recommended activities in small hydropower development - Lesotho.** Jackson, B.C.; Johnson, M.L. (National Rural Cooperative Association, Washington, DC). 1983. NTIS, PC A24/MF A01. File Number DE84007682. (CONF-830939—Vol.1).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

A two-person team spent three weeks in Lesotho under the sponsorship of USAID-ST/EY to recommend hydropower activities appropriate for the country. The team found that Lesotho has the physical features appropriate for large hydropower, but that wide-scale implementation of mini- and micro-hydropower installations would be difficult. The extreme variations in seasonal flows and the low specific discharges make seasonal storage a requirement for significant amounts of dependable power. All of Lesotho probably has 20 to 40 potentially developable micro-hydro sites in the 5 to 100 kW range. The comparatively high cost of US $3000 to $6000 per kW installed are due to the higher cost of low-head equipment and the need for long, lined headraces. Since installations will be shut down 20 to 30% of the year due to lack of river flow, locations with existing diesel units for back up are preferred. Principal construction problems are site access, stream sediment load and deposition, and active stream bank and hill slope erosion.

30096 (TVA/PUB—84/21a, pp 249-256) **Small hydro in Thailand.** Bunk, G.M. (International Engineering Co., Darien, CT). 1983. NTIS, PC A24/MF A01. File Number DE84007682. (CONF-830939—Vol.1).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

The Kingdom of Thailand is attempting to reduce its dependence upon imported oil through the development of indigenous energy resources, including hydropower. The Thai electric power system has grown phenomenally during the past 20 years; and hydropower has figured prominently in this growth, mostly through the development of relatively large projects. Because most of the larger hydro sites have been developed or are not available for development at this time, increased emphasis has been placed on development of the country's substantial small hydro resources. Hydro development in Thailand has few impediments; and given an improved world economic outlook, continued development of hydro projects seems certain.

30097 (TVA/PUB—84/21a, pp 257-265) **Development of small-scale hydroelectric power in Puerto Rico.** Gebhard, T.G. Jr.; Rankin, W.H.; Scott, R.D. 1983. NTIS, PC A24/MF A01. File Number DE84007682. (CONF-830939—Vol.1).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

The terrain and stream flow characteristics of Puerto Rico have made hydroelectric power a historically important energy source on the island. In 1936, hydroelectric power provided 66% of the electrical energy. With the growth of an industrialization program in the 1960's, some of the smaller and older hydroelectric sites were retired as oil-fired steam and combustion turbines were installed. Currently, Puerto Rico has an electrical generation system with a nominal capacity of over 4126 MW from oil-fired turbines and 98 MW from hydroelectric turbines. The electrical demand has decreased due, in part, to high electrical prices. The future for hydroelectric power is linked to the cost of fuel for electrical generation. The opportunities for the development of small-scale hydroelectric power include renovating retired facilities, expanding capacity at existing facilities, adding electrical generation to existing dams, and constructing new impoundments and diversion dams. Puerto Rico has many sites with head and flow characteristics typical of economically feasible installations. Although Puerto Rico is promoting the establishment of demonstration projects, no hydro projects have proceeded through the island's permitting process.

30098 (TVA/PUB—84/21b, pp 605-614) **Case study of US-China cooperation in unified resource development.** Armentrout, D.R.; Salisbury, R.F. (Tennessee Valley Authority, Knoxville). 1983. NTIS, PC A99/MF A01. File Number DE84008049. (CONF-830939—Vol.2).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

When diplomatic relations with the People's Republic of China (PRC) were established in the 1970s, the world rediscovered a land rich with resources and inhabited with a hard-working people. The government has since set plans to develop the land and its people with the cooperation of western countries. One of the keys to successful development has always been the availability of power - principally electric power for industry and homes. The cooperative activity between the USA and PRC in the area of hydro power development are discussed.

30099 (TVA/PUB—84/21c, pp 1545-1547) **Opening remarks.** Freeman, R. (Tennessee Valley Authority, Knoxville). 1983. NTIS, PC A20/MF A01. File Number DE84007687. (CONF-830939—Vol.3).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

The efforts of the Tennessee Valley Authority in managing the water resources of the Tennessee Valley are discussed. These efforts include studies of dissolved oxygen content in the regions reservoirs, environmental problems and water quality, control of soil erosion, management of recreational areas and land use studies.

30100 (TVA/PUB—84/21c, pp 1548-1565) **Geopolitics of energy: a global perspective on energy, technology, and employment.** Patton, F.S. (Union Carbide Corp., Oak Ridge, TN). 1983. NTIS, PC A20/MF A01. File Number DE84007687. (CONF-830939—Vol.3).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

The global economy now over shadows the economies of individual nation-states to such an extent that their domestic markets and manufacturers are not viable as self-contained arenas. In this newly dominant global economy political, social, economic, and energy concerns are interrelated. Authorities charged with decision making - even on a parochial basis - cannot prudently plan without maintaining conversance with these sectors on a global scale. The circumstances which have contributed to the changed status are discussed.

30101 (TVA/PUB—84/21c, pp 1566-1573) **National hydropower study.** Blakey, L.H. (Army Corps of Engineers, Knoxville, TN). 1983. NTIS, PC A20/MF A01. File Number DE84007687. (CONF-830939—Vol.3).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

The results of the Corps of Engineers' National Hydropower Study are discussed. The role of the Federal government in financing not only hydropower but all water resource development is also discussed.

30102 (TVA/PUB—84/21c, pp 1574-1582) **Waterpower '83, state of the industry - a summary of the conference.** Domer, R.G.; Salisbury, R.F. 1983. NTIS, PC A20/MF A01. File Number DE84007687. (CONF-830939—Vol.3).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

The Emphasis of the past two Waterpower conferences was very heavy on small hydropower development. The need to make the Conference grow into something broader and, hopefully, more beneficial to the profession is emphasized. The two goals to accomplish this objective are: expand the scope to encompass all aspects of hydropower. This is in keeping with TVA's approach to hydropower and is part of an ever-increasing awareness that no single area of the business can stand alone; and bring together a wide range of professions and, within those professions, a diversity of specialties. The conference then becomes an avenue of communication that probably would not exist otherwise. In an age of information explosion, this can only help us all do a better job.

30103 (TVA/PUB—84/21c, pp 1583-1586) **Water in the 21st century.** Willis, W.F. (Tennessee Valley Authority, Knoxville). 1983. NTIS, PC A20/MF A01. File Number DE84007687. (CONF-830939—Vol.3).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

The activities of the Tennessee Valley Authority in the development of the water resources of the Tennessee Valley region are summarized. Such activities as land use and management, reclaiming of abandoned mine lands, erosion control, reservoir management, pollution control and water quality studies are reviewed.

1302 Site Geology And Meteorology

30104 (AD-A—152107/9/XAB) **Cooper River rediversion project, St. Stephen Powerplant, St. Stephen, Carolina: engineering considerations and instructions for field personnel.** (Army Engineer District, Savannah, GA (USA)). Jul 1979. 57p. NTIS, PC A04/MF A01.

This manual is intended to serve as a technical guide for the Resident Engineer and his personnel, together with such personnel of the Construction Division who are directly responsible for the construction. These engineering considerations and instructions are intended to explain the various considerations and assumptions, especially regarding field conditions, involved in the design and in the preparation of the contract plans and specifications. They are also for the purpose of commenting upon and explaining certain requirements of the specifications and to establish the requirements necessary to provide Government acceptance testing. Contents: Instructions on Soils and Geology Technical Specifications; Soils and Geology Drawings; Concrete and Concrete Materials; Structural Design and Erection Considerations; Mechanical; Electrical.

30105 (NP—5750808) **Runoff conditions at Kuussuup Tasia, Christianshaab, estimated by modelling.** Braithwaite, R.J.; Hoejmark Thomsen, H. (Groenlands Geologiske Undersoegelse, Copenhagen (Denmark)). Feb 1984. 25p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85750808.

Kuussuup Tasia, east of Christianshaab, has been identified as a potential site of a hydropower project to supply energy to Christianshaab, and possibly to Egedesminde. The present report describes an assessment made at the Geological Survey of Greenland (GGU) of the runoff conditions in connection with investigations supported by the EEC European Regional Development Fund. The work is based upon the GGU runoff-climate model, together with four years of runoff data from Kuussuup Tasia measured by the Greenland Technical Organization (GTO) as well as long-term climate recordings in Jakobshavn by the Danish Meteorological Institute. In the first round of calculations the model greatly overestimates runoff, probably due to the uncertain delineation of the Inland Ice sector draining into the area. However this overestimation is corrected by calibration of the model with the observed runoff data. The results show that the 1980-1983 measured runoff was a little low, both with respect to the 1961-1983 base period and compared to estimated runoff since 1880. The total runoff from Kuussuup Tasia and a nearby ice-dammed lake Tiningnilik appears to be sufficient for the power supply required for Christianshaab and Egedesminde. However, full exploitation of the hydropower potential in the area requires a very large reservoir capacity. The need for some further investigations in the area is stressed.

1303 Plant Design And Operation

REFER ALSO TO CITATION(S) 30095, 30096, 30097, 30098, 30228, 30239, 31042, 31043, 31044, 31045, 31046, 31047

30106 (CONF-7907129—, pp 9-28) **Summary remarks, conclusions, and recommendations of work groups.** May 1980. NTIS, PC A11/MF A01. File Number DE84005144.

From UCLA small-scale hydro resources development western regional workshop; Pomona, CA, USA (30 Jul 1979).

The following topics relating to the development of small-scale hydroelectric resources in the West are discussed: engineering and retrofit design, financing and development, licensing and regulation, environment, marketing and utility interface, information and technology transfer, feasibility and economics, and hybrid systems.

30107 (DOE/R8/00434—T1) **Small hydroelectric power plant demonstration project. Final technical report.** (Rocky Mountain Biological Lab., Crested Butte, CO (USA)). [1985]. Contract FG48-79R800434. 6p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85011343.

The Rocky Mountain Biological Laboratory has completed construction of a small scale hydroelectric power plant. The plant utilizes water from the Laboratory's domestic water supply, can generate a maximum of 7.5 kW, and supplies electricity to the Laboratory's dining hall for space heat, cooking, and hot water.

30108 (TVA/PUB—84/21a, pp 346-355) **Estimating micro-hydro potential in western North Carolina.** Berkowitz, S.J.; Ayers, H.G. (North Carolina Div. of Health Services, Raleigh). 1983. NTIS, PC A24/MF A01. File Number DE84007682. (CONF-830939—Vol.1).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

A methodology was developed for estimating the micro-hydro potential of streams in the southern Appalachian mountain region of western North Carolina. Micro-Hydro sites identified, could produce an average of five to 200 kilowatts, utilizing naturally available stream flow and relief. The methodology was designed to yield consistent, site specific estimates of the maximum feasible production potential throughout the region, making optimal use of available hydrologic and topographic data. The essence of the methodology is the techniques developed for estimating flow and head parameters. An isoclinal map was developed showing normalized average flows available for micro-hydro production. Criteria were established for determining the minimum elevation drops and slopes above which sites would be economically feasible. All sites meeting these criteria were identified, and the maximum economically feasible production potential was determined for each site. Utilizing this methodology, 1591 feasible micro-hydro sites were identified in the study area, with a total average production potential of 28,151 kilowatts. The study area is felt to have the greatest micro-hydro potential of any comparable region in the eastern US.

30109 (TVA/PUB—84/21a, pp 356-365) **Microhydropower Handbook.** McKinney, J.D.; Sommers, G.L. (Idaho National Engineering Lab., Idaho Falls). 1983. NTIS, PC A24/MF A01. File Number DE84007682. (CONF-830939—Vol.1).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

A new Microhydropower Handbook has recently been compiled. Funded by the US Department of Energy (DOE), this new Handbook contains more than 800 pages and is much more comprehensive and detailed than the previous DOE booklet on microhydropower. The purpose of this paper is to familiarize you with the Handbook, its content and organization. In this Handbook, microhydropower is defined as hydropower produced in quantities of 100 kW or less. The Handbook has been planned and written so that a lay person, with mechanical aptitude, will have sufficient information to evaluate site potential, lay out a site, select and install equipment, and finally, operate and maintain the completed system. The Handbook is divided into two volumes. Volume one establishes a foundation for the engineering principles, leads the individual through design, construction and operation, and provides information on obtaining financing and on licensing. Volume two is the appendices containing supplementary information, federal and state agencies and their addresses, glossary, and useful forms.

30110 (TVA/PUB—84/21a, pp 376-382) **1000 MW to 5 MW - thinking small: a large utility's experience with its small hydro projects.** Sayed, W. (New York Power Authority). 1983. NTIS, PC A24/MF A01. File Number DE84007682. (CONF-830939—Vol.1).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

The New York Power Authority (Authority) has been involved, until recently, in the construction of large power plants and has, therefore, found it challenging to scale down its design requirements in building small hydro power plants. Control schemes, for example, which are essential to large units are too sophisticated for use on small hydro plants and we, therefore, find the designer and the operator trying to reach a compromise. The architect-engineers too have had the need to look inward to modify their design concepts from large units to suit the small hydro power projects. Another area where scale-down in design is not possible is the interconnection costs associated with designing and installing line protection and data transmission to the remote control center. Between small hydro plants, the costs associated with the electrical system is essentially constant, the only variable being the number of generator breakers.

30111 (TVA/PUB—84/21a, pp 383-392) **Assessing the risk of low water.** Cunningham, C.H. (International Engineering Co., Inc., Darien, CT). 1983. NTIS, PC A24/MF A01. File Number DE84007682. (CONF-830939—Vol.1).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

Most projections of annual energy generation for small hydro facilities are based on flow duration curves and are expressed in terms of average annual energy. However, time series data are required to assess the variability of the annual energy generation. A technique has been developed that uses data recorded by the USGS in a computer model of a proposed hydro installation to quantify the expected variation in annual energy production. The accuracy of the projections of the average, as well as of the variability of, annual generation is highly dependent upon the accuracy of the

USGS data and the computer model. Topics covered include: how USGS gage data is used in the simulation of the proposed facility's operation; what factors must be included in the computer model of the proposed installation and why a site-specific model is required; and how to use the annual energy generation statistics to check that an appropriate probabilistic model has been selected. Lastly, a comparison is made between the variability of the annual energy generation estimated on the basis of the computer model (using daily flow measurements directly) and the variability of the annual average stream flow. This analysis shows that considerable error will be introduced in the estimate of the variability if average annual flow is used.

30112 (TVA/PUB—84/21a, pp 230-238) **Status of small hydroelectric development in Ontario, Canada.** Graham, D.S. (Univ. of Western Ontario, London). 1983. NTIS, PC A24/MF A01. File Number DE84007682. (CONF-830939—Vol.1).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

In Canada, electric power generation is a provincial jurisdictional matter, and is provided in Ontario by a unique public utility (Ontario Hydro). Private development of small hydro sites is now permitted and the Province of Ontario has embarked upon a small hydro encouragement program. Its concept is similar to that of the US DOE small hydro programs in many respects, but its progress will be affected by significant political/institutional differences with the US. Seven demonstration projects are now underway. Development of the industry is currently limited by several factors; the most important of which are unrealistically low prices offered for the energy and power by Ontario Hydro, and lack of an effective legal and administrative structure for project ownership and licensing.

30113 (TVA/PUB—84/21a, pp 274-283) **Hydropower civil works - procedures and pitfalls.** Good, A.M. 1983. NTIS, PC A24/MF A01. File Number DE84007682. (CONF-830939—Vol.1).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

The processes necessary to direct the design and construction of the structures required to house and service hydroelectric generation facilities, from the point of view of the developer are discussed. The design issues reviewed include: selection of the engineer, conceptual design, and project design, detailing aspects of access, hydraulics, structural requirements and architectural features. Construction aspects studied include: selection of the contractor, quality assurance and inspection, and contractor's procedures.

30114 (TVA/PUB—84/21a, pp 284-296) **Experiences on mini hydro feasibility studies for isolated sites in Alaska and Malaysia.** Little, G.E. (Tudor Engineering Co., San Francisco, CA). 1983. NTIS, PC A24/MF A01. File Number DE84007682. (CONF-830939—Vol.1).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

The methodologies, assumptions, and criteria utilized in conducting feasibility studies for mini-hydro hydroelectric projects for 41 sites in peninsular Malaysia and 4 sites at isolated sites in Alaska are described. All sites were simple run-of-the-stream diversion projects consisting of a small diversion weir, an intake structure, a penstock with an access road, the power plant, and a transmission line extending to the point of use. The general procedures utilized in conducting the studies are covered, followed by a discussion of the key aspects including hydrologic methodologies, energy planning, pre-reconnaissance activities, field investigation procedures, field surveys, project layouts, turbine/generator equipment, cost estimates, economic analysis, and excess energy utilization.

30115 (TVA/PUB—84/21a, pp 297-305) **Truckee-Donner PUD's small-scale hydro at Boca Dam.** Peters, K.B.; Conwell, J.C. (James Hansen and Associates, Inc., San Francisco, CA). 1983. NTIS, PC A24/MF A01. File Number DE84007682. (CONF-830939—Vol.1).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

The planning process, the coordination between Truckee-Donner Public Utility District (Truckee), and US Bureau of Reclamation (Reclamation), and the engineering considerations in developing a larger, more economical hydroelectric facility at Boca Dam are described. During the planning process for developing a hydroelectric facility, four separate proposals were made; one by Reclamation, and three by Truckee. The latest proposal for the Federal Energy Regulatory Commission (FERC) license application was based on a reanalysis of the flow duration curve, physical facilities, estimated generation benefits, and coordination between Truckee and Reclamation.

30116 (TVA/PUB—84/21a, pp 306-315) **Standardized design components for mini-hydro development.** Pruitt, L.L. (Stanley Consultants, Inc., Muscatine, IA). 1983. NTIS, PC A24/MF A01. File Number DE84007682. (CONF-830939—Vol.1).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

A series of standardized designs has been developed for use in local and regional mini-hydro programs. Much of the exploratory work involved in development of these tools was performed in the recently completed Malaysian mini-hydro program. During that effort, over 200 potential mini-hydro project locations were screened to select the final 41 sites for which detailed designs were prepared. Over 150 possible locations for mini-hydro development were visited in the jungle areas of the east coast states of peninsular Malaysia. In addition to the on-the-ground reconnaissance, data gathering included assembling information regarding site accessibility, hydrology, geologic characteristics, and power needs at nearby villages. Feasibility studies concluded that 38 of the 41 sites were economically justifiable, based on rigid international funding agency criteria. The standardized designs are based on detailed site reconnaissance, survey, and optimization of the 41 project locations. Emphasis is placed on run-of-river projects which would typically be located in remote areas. Capacities range from 50 kW to just over 1000 kW with a broad spectrum of hydraulic heads (from 8 to over 400 meters). A typical mini-hydro installation includes a low diversion dam, intake chamber with trash rack, settling basin, penstock, powerhouse, tailrace, electric switchyard, and transmission line. Penstock sizes range from 300 to 1800 mm diameter; lengths are 0.1 to 1.8 kilometers. Three types of turbines are considered, depending upon the head and flow conditions available. The standardized design of the significant mini-hydro project components which may be useful for development at other locations is discussed.

30117 (TVA/PUB—84/21a, pp 316-324) **French Broad EMC's Capitola Project - 3 MW with 14 feet of head.** O'Neill, T.J. (Tudor Engineering Co., Atlanta, GA). 1983. NTIS, PC A24/MF A01. File Number DE84007682. (CONF-830939—Vol.1).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

The Capitola Hydroelectric Project is a small-scale, low-head facility currently under construction on the French Broad River in Marshall, North Carolina, approximately 70 miles east of Knoxville. The project is being developed by the French Broad Electric Membership Corporation, which serves approximately 20,000 customers in a six county region northwest of Asheville. The proposed Capitola Project will generate 3000 kilowatts of power with a rated head of 14 feet. All power and energy will be utilized internally by French Broad EMC and thus will supplant power purchases. The project will make use of an existing, eight-foot high dam which serves to divert water into a 550-foot long, headrace canal. The dam, which was constructed in the early 1900's, will require some rehabilitation work and will be fitted with 3 feet of adjustable flashboards along its crest. The project will generate approximately 20 million kilowatt-hours per year. Currently, on-site construction of the project is underway. A contract has been let to furnish and install two 1500 kilowatt horizontal Kaplan turbine/generators. The project is expected to come on line in late 1984. Total cost of the project is approximately $8,000,000.

30118 (TVA/PUB—84/21a, pp 325-334) **Economical solution of low-head turbine application from a hydraulic point of view.** Ulith, P.; Wolfram, F. (J.M. Voith GmbH, Heidenheim, West Germany). 1983. NTIS, PC A24/MF A01. File Number DE84007682. (CONF-830939—Vol.1).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

For the development of hydro power potential with low head, four solutions are presented. For an assumed example, different types of turbines were laid out, which, in their turn also influence the conception of the powerhouse. The head losses involved in the different conceptions, as well as the efficiencies, are presented. The annual energy productions attainable with the different types of turbines result in an order of rank from the hydraulic point of view. Finally, with the help of assumed factors regarding costs of powerhouse and machines on the one hand the utilizable energy on the other, a comparison between the different conceptions is attempted from the economical point of view, in order to assist the planning engineer in search of the optimal solution.

30119 (TVA/PUB—84/21a, pp 335-345) **Hydropower - tailoring it to fit.** Bruton, O.W. (Army Corps of Engineers, Portland, OR). 1983. NTIS, PC A24/MF A01. File Number DE84007682. (CONF-830939—Vol.1).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

In the early phases of hydropower evaluation, economic techniques play a most important role. Some of the techniques used in determining a hydro project's economic feasibility are presented and the optimum development for the site is discussed. Before a project can move into the design stages, an optimization or scoping process must be performed. This process must be accomplished using economic procedures, tempered by marketability and environmental considerations. Project benefits are most commonly determined by either of the following methods: the cost of the alternative thermal plant, or the value of displaced thermal generation (fuel displacement). Procedures for determining a project's energy output and dependable capacity are also discussed. Finally, examples of the two different evaluation techniques taken from two recently completed feasibility level project studies are discussed. The emphasis is on Federal development; however, these procedures can be a useful tool in assisting both public and private planners in evaluating and developing hydropower resources.

30120 (TVA/PUB—84/21a, pp 3-12) **4.2 MW hydro power plant for Radio Station HCJB, Papallacta, Ecuador, S.A.** Moore, S.E.; McKay, H.G. III; Howell, R.E. (Radio Station HCJB, Quito, Ecuador). 1983. NTIS, PC A24/MF A01. File Number DE84007682. (CONF-830939—Vol.1).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

International Radio Station HCJB, more commonly known as The Voice of the Andes, is a high powered private missionary short wave radio station located in Ecuador, S.A. The station is part of the organization (WRMF) World Radio Missionary Fellowship. This short wave radio station's broadcast week contains over 500 program hours and around 2230 transmitter hours. The transmitters have a combined signal power of over 1 million watts which can be heard around the world. The energy to power these large radio transmitters, plus other ancillary loads, is provided by a small hydro electric power station which is owned and operated by HCJB. The plant has two small hydro units, 1.8 MW capacity and 4.2 MW capacity. The 1.8 MW unit is a used, 1900 vintage horizontal turbine/generator unit which was transported from the US to Ecuador and installed in 1965. In 1982, a new 4.2 MW horizontal turbine/generator unit was installed to provide energy for larger and more modern short wave transmitters. The power station is located high in the Andes Mountains of Ecuador on the Papallacta River. This small river is part of the head waters of the Amazon River. The electrical energy is transmitted to the west across the continental divide some 40 km to the radio station transmitter site. The stream flow of the Papallacta River is seasonal. The dry season (low flow) occurs from October to February while the wet season (high flow) is March through September. The proper management of the highly variable stream flow is critical to the efficient and effective operation of the two units. The water source will be monitored and managed by a uniquely designed reservoir and stream flow monitoring system. The design and construction of the 4.2 MW hydroelectric power plant are discussed.

30121 (TVA/PUB—84/21a, pp 13-22) **Hydroelectric development activities of rural electric systems.** Prichett, W. (National Rural Electric Cooperative Association, Washington, DC). 1983. NTIS, PC A24/MF A01. File Number DE84007682. (CONF-830939—Vol.1).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

The Rural Electric Systems are well acquainted with hydropower. The backbone of the Federal power supply system upon which the Rural Electric Systems depend is hydroelectric. In addition, during the 1950's, the Rural Electric Systems, themselves, built and/or owned and operated 43 small hydroelectric generating plants. During the 1960's and 1970's, as these plants became antiquated and expensive to operate, they were abandoned and fell into disrepair (as, of course, did many other similar facilities in the US). Today, the Rural Electric Systems are very active in renovating these plants along with developing the hydro potential at additional sites in their service territories. Since the hydroelectric development process in the US follows a process of permitting, licensing, and finally plant construction and operation, these many Rural Electric small hydro activities are discussed according to this logical sequence.

30122 (TVA/PUB—84/21a, pp 23-32) **Rehabilitation of the orchard mesa turbine-pump units.** Mehring, C.W. (Tipton and Kalmbach, Inc., Denver, CO). 1983. NTIS, PC A24/MF A01. File Number DE84007682. (CONF-830939—Vol.1).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

The Orchard Mesa Irrigation District and its predecessors have used water power to lift its irrigation supplies from its power canal to its distribution canals since approximately 1910. The four units presently in use were installed in 1925 and have been in continuous service during the irrigation season since that time. The water supply for the project is the flow of the Colorado River which contains considerable amounts of sediments. The abrasive nature of the water supply causes wear to the impellers and runners of the units, and the capacity of the units gradually reduces during the irrigation season. Each year, during the non-irrigation season, it is necessary to tear down each unit, build up the impeller and runner, and reassemble the unit. The efficiency of the units has gradually decreased over the years to the point that the units can no longer satisfy the water requirements of the project. The characteristics and cost of the units that have been ordered to replace the existing units are discussed.

30123 (TVA/PUB—84/21a, pp 33-41) **Redeveloping a low head open flume power house concept to reality at Potsdam, New York.** Gannett, W. (Rist-Frost Associates, Glens Falls, NY). 1983. NTIS, PC A24/MF A01. File Number DE84007682. (CONF-830939—Vol.1).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

The Village of Potsdam, New York constructed a hydroelectric station and water treatment plant complex on the Raquette River in 1926. The powerhouse had two concrete flumes with timber intake gates. A 42-inch vertical turbine was set in one of the flumes, discharging to the tail-race through a conical steel draft tube. At the rated 9.5 feet head and 268 CFS design flow, the unit produced 150 kW for the water plant. The plant was retired in 1971. In 1976, the Village engaged Rist-Frost Associates, to examine the feasibility of redeveloping the site. Preliminary studies and financial projections showed that a redevelopment would be viable. In 1980, the redevelopment concept was refined and final designs prepared. The selected concept consisted of two 400 kW semi-Kaplan vertical turbines set in the existing flumes, with concrete elbow draft tubes for efficient outlet hydraulics. In the course of design, construction and installation, a number of interesting constraints had to be addressed. These issues included low head, limited room on site, operation flexibility requirements, and the necessity to sequence construction around an operating water treatment plant. The effects of increasing design flows were examined in a model test. How the design issues were resolved, and how the construction progressed as this small, low-head hydro project was redeveloped as an operating facility are discussed.

30124 (TVA/PUB—84/21a, pp 42-51) **Design and construction of the Granby Hydro Redevelopment Project.** Vanderburgh, M.R.; Costello, J.P.; Gill, H.S. (Acres American Inc., Buffalo, NY). 1983. NTIS, PC A24/MF A01. File Number DE84007682. (CONF-830939—Vol.1).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

The Granby Hydroelectric Redevelopment Project was the first facility of its type to be completed by an investor-owned utility in New York State since the 1973-74 oil embargo. Resolution of important issues relative to water quality and inclusion of the state dam in the license required a lengthy licensing period. Design and construction of the project was influenced to a great degree by an extremely limited site area and the need to maintain structural integrity of existing structures during dewatering and excavation. Construction commenced on site in October 1980, approximately 32 months after submission of the FERC license application. The project went into commercial operation in the spring of 1983.

30125 (TVA/PUB—84/21a, pp 52-62) **Upper mechanicville hydroelectric redevelopment project.** Case, J.J.; Sinclair, J.P. (New York State Electric and Gas Corp., Binghamton). 1983. NTIS, PC A24/MF A01. File Number DE84007682. (CONF-830939—Vol.1).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

The Upper Mechanicville Project is the first hydroelectric plant to be developed in recent years by the New York State Electric and Gas Corporation (NYSEG). The project is located at Lock and Dam No. 3 on the Hudson River about 20 miles upstream of Albany, New York. The lock and dam facilities are a part of the New York State Department of Transportation (DOT) Champlain Barge Canal navigation system. The new station, with a capacity of 16.8 MW, will replace the original generating facilities (about 5.5 MW) which were abandoned by the former owner in 1977. Design of the project relied heavily on hydraulic model studies from which the need for a number of features and design modifications, to ensure acceptable flow conditions in the intake and tailrace channels, was identified, The project is scheduled for completion in the third quarter of 1983. The new powerhouse will have two conventional vertical-shaft, double regulated, Kaplan turbines, each driving an 8.4 MW synchronous generator. The design flow is 12,000 ft^3/s and the rated net head for the turbines is 19 ft. The turbine runner diameter is 216 inches and the unit spacing is 61 ft. It must be realized, therefore, that the main feature which qualifies this project as small-scale is the relatively low head and capacity.

30126 (TVA/PUB—84/21a, pp 63-73) **Rehabilitation of timber crib hydro dam, Caribou, Maine.** Nadeua, J.H.; Lucks, A.S.; Bryant, J.H. (Stone and Webster Engineering Corp., Boston, MA). 1983. NTIS, PC A24/MF A01. File Number DE84007682. (CONF-830939—Vol.1).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

The installation of the sheet piling cutoff wall and structural repairs made to an 87-year-old timber crib dam are described. Descriptions of site investigations and cofferdam methods, as well as cost data, are also included.

30127 (TVA/PUB—84/21a, pp 74-83) **Practical applications for pumps as hydraulic turbines for small scale hydropower.** Shafer, L.L. (McGraw-Edison Co., Taneytown, MD). 1983. NTIS, PC A24/MF A01. File Number DE84007682. (CONF-830939—Vol.1).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

The use of pumps as hydraulic turbines offers many advantages for the small power producer. However, careful design reviews are required prior to their use in order to assure satisfactory operation. Pumps have been successfully applied as turbines as drives for other rotating equipment, for pressure reduction in pipelines where electrical production is a by-product and, of course, for projects where power generation for the purpose of producing electricity for a profit is the key objective. Examples of each of these types of installations are discussed, demonstrating the versatility of reverse running pumps for turbine applications.

30128 (TVA/PUB—84/21a, pp 84-93) **Machine selection and powerhouse design for small hydropower schemes.** Leyland, B.W. (Leyland Watson & Noble, Auckland, New Zealand). 1983. NTIS, PC A24/MF A01. File Number DE84007682. (CONF-830939—Vol.1).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

By optimizing and integrating the selection of machines and the design of powerhouses, both cost and complication can be reduced. These aspects are discussed and some innovative designs adopted in New Zealand are described.

30129 (TVA/PUB—84/21a, pp 94-101) **Inverted Flow Concrete-Built Siphon System.** Bourgeacq, J.P. (Page Hydro Power Systems, Inc., Iowa City, IA). 1983. NTIS, PC A24/MF A01. File Number DE84007682. (CONF-830939—Vol.1).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

The development, construction details and maintenance, and operating experience of the Inverted Flow Concrete-built Siphon System as developed in France by Mecamidi (Turbine Manufacturer) and Page Engineering (Design Engineers) are described. Advantages of the inverted flow-siphon principle are described. Its economic attractiveness and ease of incorporation into new or existing low-head dams are presented. Reduction of vibration problems inherent in many siphon systems reduces maintenance. Replacement of the normal turbine shut-off valve by a simple siphon breaker device is a reliable, simple, cost-saving alternative.

30130 (TVA/PUB—84/21a, pp 102-111) **Utilization of hydropower of small irrigation structures.** Mankbadi, R.R.; Mikhail, S.; Baz, A. (Cairo Univ., Egypt). 1983. NTIS, PC A24/MF A01. File Number DE84007682. (CONF-830939—Vol.1).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

Several hydroenergy conversion systems are considered for utilizing low-head hydro. The turbine-pump system, installed across irrigation structures is discussed. The available low-head energy is used to drive a turbine connected to a pump, to lift water for irrigation or domestic purposes. The equations governing the operation of the system are considered. For a given regulator's characteristics, a method is presented for determining the main design parameters of the system. Off-design performance of the system can be controlled to achieve maximum pumped flow all over the year. The turbine-pump system should thus be considered wherever low-head power is available and there is a demand for water to be pumped at a higher head.

30131 (TVA/PUB—84/21a, pp 112-120) **Philosophy, theory and practice of low-cost micro-hydro.** Woodward, J.L.; Boys, J.T.; Elder, J.M. (Univ. of Auckland, New Zealand). 1983. NTIS, PC A24/MF A01. File Number DE84007682. (CONF-830939—Vol.1).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

The need to reduce costs through simplification and standardization of equipment is emphasized, if stand-alone micro hydro is to become practicable. The operation and features of a modular electronic load governor developed with this in mind are described. Operated in conjunction with the load governor and capacitive excitation devices, standard induction machines offer further advantages. Operating experience to date is described.

30132 (TVA/PUB—84/21a, pp 121-130) **Low-head turbine studies for Lock & Dam 14 Power Project.** Williams, J.; Guild, D.J.; Hawks, J.E. (Tudor Engineering Co., Denver, CO). 1983. NTIS, PC A24/MF A01. File Number DE84007682. (CONF-830939—Vol.1).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

The engineering and cost studies that were recently completed for the feasibility level design, included in the FERC License Application for the Lock & Dam 14 Power Project on the Mississippi River, included an analysis of different turbine types and sizes for the hydraulic machinery features. Special studies were conducted for the turbines because of the ultra low-head (8 to 11 feet) installation, and because it was recognized that the hydraulic machinery will comprise a significant portion of the project cost. Power studies and cost estimates were prepared for different plant capacities based on either tubular, pit or siphon-type turbines. The turbine runner diameter sizes ranged from 3.6m to 5.5m. Manufacturer's information, as well as the principles of dynamic similarity, were utilized to estimate the turbine power characteristics, and the cost estimates were based on manufacturer quotes and recent bid prices. The pit-type turbines were found to have the highest power output of the three types for the same runner diameter. The preliminary cost estimates indicated that a plant with the smaller machines will have somewhat lower civil works costs per installed unit than the larger machines, but that the total civil works costs were found to remain reasonably constant as the runner diameters varied. The cost per kilowatt for the hydraulic machinery is significantly less for the larger machines than for the smaller.

30133 (TVA/PUB—84/21a, pp 131-140) **Optimization and selection of penstock and power equipment minihydro installations.** McAlister, I.J. (Stanley Consultants, Inc., Muscatine, IA). 1983. NTIS, PC A24/MF A01. File Number DE84007682. (CONF-830939—Vol.1).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

The development and use of tools for the analysis and optimization of minihydro penstock requirements are presented. A simple relation is proposed expressing penstock diameter in terms of rated power output and rated head. A similar relation for diameter in terms of rated flow and gross head is also given. Consideration is given in terms of cost to the variation in power equipment size and type when determining optimum penstock size. The relationship between power output, head, and penstock length is examined to determine a minimum slope for the feasible addition of incremental penstock length. The relationships presented are derived from recent experience on projects reflecting a wide range of minihydro site conditions.

30134 (TVA/PUB—84/21a, pp 141-150) **Small hydro turbine selection: three case studies.** Adams, B.H. (E.C. Jordan Co., Portland, ME). 1983. NTIS, PC A24/MF A01. File Number DE84007682. (CONF-830939—Vol.1).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

The selection of hydraulic turbines for small hydroelectric projects is discussed. Three projects in Maine, ranging in size from 1000 kW to 14,000 kW are used as examples. Experience to date on two of the projects is also discussed. The smallest of the three is the 1050 kW Gardiner Hydroelectric Project owned by the Swift River Company. The second project is the 4000 kW Shawmut Station Expansion on the Kennebec River owned by Central Maine Power Company. The third is the Bangor Hydro-Electric Company's West Enfield Project on the Penobscot River.

30135 (TVA/PUB—84/21a, pp 151-158) **Walterhill small hydro project.** Flew, G. (Allen & Hoshall, Inc., Nashville, TN). 1983. NTIS, PC A24/MF A01. File Number DE84007682. (CONF-830939—Vol.1).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

The Walterhill site near Murfreesboro, Tennessee, has been used as a dam for almost 180 years. Off and on for approximately 35 years, until 1940, the site was utilized to generate electric power. The dam is currently owned by the City of Murfreesboro and is used solely for the purpose of domestic raw water supply. In September 1980, the Middle Tennessee Electric Membership Corporation (MTEMC) saw the idle Walterhill site as an opportunity to develop a renewable natural resource. MTEMC retained the firm of Allen & Hoshall, Inc., to prepare a feasibility study of the installation of hydroelectric generation equipment at the site. The study was financed jointly by MTEMC, the Tennessee Valley Authority and the Tennessee Valley Public Power Association. The result of the study indicated that the Project was indeed economically feasible. However, the investigation showed that, due to the size of the installation, an economical installation could not be achieved utilizing traditional turbine/generator equipment. One alternative investigated proposed the installation of a marine thruster in place of a traditional turbine. This proved to be not only the single alternative with positive economics studied (benefit/cost ratio greater than 1.0), but, with a benefit/cost ratio of approximately 2.5, also an extremely viable project. In the section of the study related to financing, it was suggested that, due to the risk inherent with the installation of the marine thruster, MTEMC seek third party financing for the purpose of risk aversion. At this point, MTEMC is seeking such a financing arrangement and has cleared all licensing and leasing obstacles for completion of the Project.

30136 (TVA/PUB—84/21a, pp 159-167) **Wailua River hydropower study, Kauai, Hawaii.** Pennaz, J. (Army Corps of Engineers, Honolulu, HI). 1983. NTIS, PC A24/MF A01. File Number DE84007682. (CONF-830939—Vol.1).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

The US Army Corps of Engineers is actively engaged in developing small-scale hydropower on Pacific islands. Most of the islands are entirely dependent upon expensive oil-fueled generation for their power needs. Hydropower development is attractive because the islands can develop their own energy resources and become less dependent on outside sources of energy. A case study of a 5.7-megawatt hydropower plant on the island of Kauai is presented. The Wailua River Hydropower Project is a run-of-the-river project, with the intake structure and diversion dam located about 500 feet upstream of a 190-foot high waterfall. The waterfall is a significant tourist attraction and is featured on the introduction to the television show Fantasy Island. Compatibility of the project with the tourist attraction was an environmental consideration. Hydrologic considerations are interesting in that the headwaters are documented as the wettest area on earth. Water for the plant flows through an intricate network of diversion tunnels and canals used by the Lihue Plantation for sugarcane irrigation. Improvement of an irrigation intake is required for this project. Significant features of the $11.6 million project include a 250-foot long by 13-foot high intake diversion dam, a 9-foot diameter concrete underground conduit, a 72-inch diameter penstock, and 2 Francis turbines of 3.8 megawatts and 1.9 megawatts capacity.

30137 (TVA/PUB—84/21a, pp 168-176) **Generating hydropower from municipal drinking water supply systems.** Heim, W.P. (Energy and Resource Consultants, Inc., Boulder, CO). 1983. NTIS, PC A24/MF A01. File Number DE84007682. (CONF-830939—Vol.1).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

Municipal drinking water systems that are gravity fed may be tapped for hydropower. The pressurized water frequently needs to pass through pressure reducing valves prior to entering water treatment plants. By installing a turbine-generator to reduce the pressure, electricity can be produced. This arrangement has advantages and disadvantages compared to traditional small-scale hydropower projects.

30138 (TVA/PUB—84/21a, pp 177-186) **Design & evaluation of microhydroturbines (<5HP).** Marquis, J.A. (Tennessee Technological Univ., Cookeville). 1983. NTIS, PC A24/MF A01. File Number DE84007682. (CONF-830939—Vol.1).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

The primary objective of this study was to evaluate the design and performance characteristics of microhydroturbines suitable for single-user generating applications. Examples include rural farms and residencies, remote park locations or small commercial operations where at least selective or partial electric demand could be met by harnessing nearby springs or streams. During the course of the project, in consultation with individuals from this area of the country who expressed an interest in the implementation of a microhydro generating system, it was found that usable on-site heads and flows in excess of 50 ft. and 2 CFS were uncommon. Consequently, the study was confined to heads below 50 feet and flows under 2 CFS, with turbines capable of from 1 to 5 HP (3/4 to 3-3/4 kW) shaft output. The major tasks completed in the course of the study were: (1) design, construction and instrumentation of a suitable test facility, (2) selection and acquisition of representative turbine types for evaluation, (3) testing and evaluation of turbines in standard and modified configurations, and (4) formulation of conclusions and recommendations.

30139 (TVA/PUB—84/21a, pp 187-195) **Small-scale hydropower from irrigation canals.** Heggen, R.J. (Univ. of New Mexico, Albuquerque). 1983. NTIS, PC A24/MF A01. File Number DE84007682. (CONF-830939—Vol.1).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

Although intermittent and highly variable streamflows restrict hydroelectric potential throughout New Mexico, there exist possibilities for small-scale hydroelectric (SSH) development in irrigation canals. Flows in these canals have low volume, low head, and relatively constant seasonal discharge. The environmentally attractive nature of SSH, as well as the proximity of canal sites to irrigation pumping stations, make canal SSH a possible source of hydropower for pumps or other remote, small, seasonal electric demands. Engineering and economic feasibility is assessed for two demonstration sites meeting institutional, regulatory, environmental, and legal constraints. Design parameters, required equipment, power plant layout, and power production are evaluated.

30140 (TVA/PUB—84/21a, pp 196-205) **Assumptions on feasibility studies of small hydro projects.** Sant'Ana, R.F.; Li, R.M. (Universidade Federal do Parana, Curitiba, Brazil). 1983. NTIS, PC A24/MF A01. File Number DE84007682. (CONF-830939—Vol.1).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

Assessing the feasibility of small hydro projects often requires the approximation of many key factors in the initial phases because of unavailability of data and/or study cost constraints. A three-level approach method identifying critical variables for the characterization of a feasible project is suggested. The effect that changes in those variables (data values or assumptions) may have on the definition of the optimum plant size and its correspondent economic/financial indices is analyzed.

30141 (TVA/PUB—84/21a, pp 206-212) **Present situation of small hydropower development in Japan.** Matsumura, Y. (Electric Power Development Co., Ltd., Japan). 1983. NTIS, PC A24/MF A01. File Number DE84007682. (CONF-830939—Vol.1).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

The current state of hydropower development in Japan is described including the various measures taken on research and development and the expediting of small hydropower exploitation, mainly in the field of civil engineering.

30142 (TVA/PUB—84/21a, pp 213-222) **Standardized turbines for mini hydro plants.** Eissfeldt, G. (Voith Hydro Inc., Upper Saddle River, NJ). 1983. NTIS, PC A24/MF A01. File Number DE84007682. (CONF-830939—Vol.1).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

Renewed awareness of energy problems has prompted governments throughout the world to promote the development of mini hydro power. Particularly in the United States, there is a possibility of implementing mini hydro power projects only if their overall economy can be evidenced. The principal factors for this are: development cost, operating cost, and attainable yields. All three factors are influenced to a considerable extent by the mechanical equipment. The increasing demand for low-cost turbines of proven design for mini hydro plants has prompted several manufacturers to develop standardized programs. The success of those programs will depend on whether they can meet the individual requirements of the hydro power stations. The standard program of mini-turbines is described. This program has been developed on the basis of the following requirements: (1) long service life, (2) optimum performance, (3) low maintenance, and (4) easy erection. The procedure of standardization is described on the basis of an example of a Pelton turbine, beginning with the determination of the range of application up to the selective diagram.

30143 (TVA/PUB—84/21a, pp 223-229) **Connecting small hydroelectric generation onto the power system.** Ballentine, C.L. (Tennessee Valley Authority). 1983. NTIS, PC A24/MF A01. File Number DE84007682. (CONF-830939—Vol.1).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

Some of the problems associated with connecting generators to distribution systems are discussed. Although these problems are significant, they can be overcome if dealt with properly. Two generating installations are discussed and suggested design presented.

30144 (TVA/PUB—84/21b, pp 585-594) **Computer analysis and field correlation from the hydraulic transient program CORA.** Deitz, R.E. (Allis-Chalmers Fluid Products Co., York, PA). 1983. NTIS, PC A99/MF A01. File Number DE84008049. (CONF-830939—Vol.2).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

In 1976, a sophisticated computer program CORA was developed to analyze the hydraulic transients generated in complex penstock systems. More than 200 various hydraulic systems have been analyzed using CORA with over 40 field correlations. Some of the more interesting applications and results are discussed. Computer plots of the various analyses and some field correlations are included.

30145 (TVA/PUB—84/21b, pp 625-634) **Homathko development.** McIntosh, I.F.; Kadak, P.A. (British Columbia Hydro, Vancouver). 1983. NTIS, PC A99/MF A01. File Number DE84008049. (CONF-830939—Vol.2).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

There are abundant sources of hydroelectric power available in British Columbia, Canada's westernmost province. B.C. Hydro, a provincial crown corporation, currently provides electric service to areas containing 93% of the 2.6 million people living in British Columbia. B.C. Hydro is studying possible hydroelectric development of the Homathko River, located about 270 km northwest of Vancouver, British Columbia. Preliminary engineering and environmental studies, completed in early 1982, recommended that a development scheme, consisting of four projects having a generating capacity of 900 MW and producing 4800 GW.h of energy annually, be explored in greater detail. The studies, now in progress, needed to establish the engineering feasibility and determine the environmental consequences of this development are described.

30146 (TVA/PUB—84/21b, pp 635-644) **Structural solutions to unique architectural features at Richard B. Russell Powerhouse.** Granade, C.J. Jr. (Army Corps of Engineers, Mobile, AL). 1983. NTIS, PC A99/MF A01. File Number DE84008049. (CONF-830939—Vol.2).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

The Richard B. Russell Project is located on the Savannah River, between Georgia and South Carolina. The powerhouse was designed by the Mobile District for the Savannah District and is presently under construction. During the design phase the firm of Marcel Breuer and Associates was selected to provide architectural enhancement of the superstructure and functional integration of public areas with the general powerhouse design. The resulting architectural design by Marcel Breuer produced some unique structural problems which required a considerable amount of study, investigation, and innovation. This project illustrates how the structural engineer and the architect can work together to provide a structurally adequate and safe building and yet preserve the desired architectural effects.

30147 (TVA/PUB—84/21b, pp 645-654) **Sidney A. Murray, Jr. Hydroelectric Station.** Lancaster, J.B. Jr.; Renau, G. (Forte and Tablada, Inc., Baton Rouge, LA). 1983. NTIS, PC A99/MF A01. File Number DE84008049. (CONF-830939—Vol.2).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

The town of Vidalia, Louisiana, is at the present time implementing a low head hydroelectric scheme in which some of the most advanced techniques in the world will be incorporated. The project, located in the State of Louisiana, will use a portion of the water diverted from the Mississippi River to the Red/Atchafalaya Rivers at the US Corps of Engineers' Old River Control Project. The Sidney A. Murray, Jr. Hydroelectric Station will have eight bulb turbine units with total installed capacity of 192 MW. The feasibility studies and preliminary design showed that although the available head was very low (averaging 14 feet) it was possible to make the project feasible by using new techniques to lower the construction cost. Some of the special features incorporated in the project are described.

30148 (TVA/PUB—84/21b, pp 655-664) **Design concept of Shuikou Hydroelectric Project, China.** Degong, Y.; Sarkaria, G.S. (ECHIDI-East China Hydroelectric Investigation and Design Institute, Hangzhou). 1983. NTIS, PC A99/MF A01. File Number DE84008049. (CONF-830939—Vol.2).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

The proposed Shuikou Hydroelectric Project on the Min River will have an installed capacity of 1400 MW. Principal features of the project are: a 100 m high concrete gravity dam, an overflow type spillway with a capacity of 53,000 m^3/s, a navigation lock and a 7-unit powerhouse. Selection of the design concept, arrangement of the project facilities and the plan for diversion of the river during construction are described.

30149 (TVA/PUB—84/21b, pp 674-681) **Installation of a hydroelectric generating plant at the Ullum Dam.** Moore, E.T.; Martin, D.A.; Lhez, H.H. (Harza Engineering Co., Chicago, IL). 1983. NTIS, PC A99/MF A01. File Number DE84008049. (CONF-830939—Vol.2).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

How in the interest of economy, one large generating unit was adapted to the limited space provided in an existing dam where originally three smaller units had been contemplated is discussed. Operational restraints and regulating characteristics are also discussed.

30150 (TVA/PUB—84/21b, pp 682-691) **River control at a very large hydropower project.** Sarkaria, G.S. (International Engineering Company, Inc., San Francisco, CA). 1983. NTIS, PC A99/MF A01. File Number DE84008049. (CONF-830939—Vol.2).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

Construction of Itaipu Hydropower Project reached a major milestone in October 1982, when the dam was completed and the reservoir filled. The spillway has been in almost continuous operation since November 1982. The following aspects of the 12,600 MW project on the border between Brazil and Paraguay, which are related to the control of the river, are discussed: 1) diversion of the river in 1978, 2) closure of the diversion sluices and first filling of the reservoir, and 3) the spillway and its first operation.

30151 (TVA/PUB—84/21b, pp 692-699) **Underwater lake tapping in Alaska.** Hougen, O. (International Engineering Company, Inc., San Francisco, CA). 1983. NTIS, PC A99/MF A01. File Number DE84008049. (CONF-830939—Vol.2).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

In Northern Europe, lake tapping is a conventional engineering task to utilize the natural storage in a lake without building a dam. Currently, the 20-MW Tyee Lake Hydroelectric Project in southeast Alaska is using this technique. Lake tapping has been used on other projects in the US; however, this is probably the first time a lake tap has been performed in the States directly from the power tunnel with the so-called wet method. The planning, design, and construction of the Tyee lake tap are described.

30152 (TVA/PUB—84/21b, pp 700-709) **Hydroelectric development of a large irrigation system.** Butler, A.J.; Taylor, W.H.; Russell, D.P. (Schuchart and Associates, Inc., Seattle, WA). 1983. NTIS, PC A99/MF A01. File Number DE84008049. (CONF-830939—Vol.2).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

The Columbia Basin Irrigation System has a number of natural and man-made sites where the flowing water drops 30 feet or more. The program to develop hydroelectric power at four of these sites is described. Plant sizes range from 2 MW to 92 MW. Environmental and social effects are discussed in the context of the federal licensing process.

30153 (TVA/PUB—84/21b, pp 731-740) **Mechanical design of the Bonneville second powerhouse.** Moentenich, B.L. (Corps of Engineers, Portland, OR). 1983. NTIS, PC A99/MF A01. File Number DE84008049. (CONF-830939—Vol.2).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

The construction of large upstream storage reservoirs on the Columbia River and the need for efficient river management required additional hydraulic capacity at the Bonneville Project. In May of 1981, power-on-line (POL) was achieved for a 560 megawatt capacity second powerhouse. The design, selection, and physical description of the major mechanical systems and sub-systems are discussed. Also discussed are problems experienced during initial operation of the plant. All of the generating units are now operating and the powerhouse was officially dedicated on June 1, 1983.

30154 (TVA/PUB—84/21b, pp 751-760) **Kingsley Hydroelectric Project.** Hamilton, E.L.; Wiedemann, P.F. (Central Nebraska Public Power and Irrigation District, Holdrege). 1983. NTIS, PC A99/MF A01. File Number DE84008049. (CONF-830939—Vol.2).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

A 50 MW hydroelectric turbine-generator unit is being constructed at an existing irrigation water storage dam and reservoir. Kinglsey Dam and Lake McConaughy are located in west central Nebraska. The project is share by The Central Nebraska Public Power and Irrigation District and the Nebraska Public Power District. Water flows must be maintained from Lake McConoughy during construction. A minor flow is necessary fall, winter and spring and major flows are needed for irrigation in the summer. The existing downstream Keystone Diversion Dam has been modified to allow Lake Ogallala, between the two dams, to be used as a re-regulating reservoir.

30155 (TVA/PUB—84/21b, pp 761-770) **Friant Power Project: non-federal power at a reclamation facility.** Boudreau, J.E.; Richardson, J.L.; Isbester, T.J.; Conwell, J.C. (Friant Power Authority, Terra Bella, CA). 1983. NTIS, PC A99/MF A01. File Number DE84008049. (CONF-830939—Vol.2).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

Designs for powerplants at Friant Dam were produced through the challenging cooperative efforts of Tudor Engineering Company and the Bureau of Reclamation. Complex problems successfully resolved included penstock tie-in, valve submergence, energy dissipation, time constraints, and lining limitation. Several of the problems were solved by the use of a physical model.

30156 (TVA/PUB—84/21b, pp 771-780) **Experience curves for selection of modern low-head turbines.** Kpordze, K.C.S.; Warnick, C.C. (Univ. of Idaho, Moscow). 1983. NTIS, PC A99/MF A01. File Number DE84008049. (CONF-830939—Vol.2).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

Experience curves and procedures for preliminary selection of turbine speed and diameter have been developed for bulb, tubular and cross-flow turbines. This is based on regression analysis of manufacturer's data on over 300 manufactured turbines.

30157 (TVA/PUB—84/21b, pp 781-790) **Recent developments of the Turgo Impulse Turbine.** Watson, A.L. (Gilbert Gilkes and Gordon Ltd., Kendal, England). 1983. NTIS, PC A99/MF A01. File Number DE84008049. (CONF-830939—Vol.2).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

The choice of hydraulic turbine to give maximum return of revenue from the typical exceedance curve is a difficult decision to make. The virtue of the impulse turbine for this purpose with its good part load efficiency and simplicity of design is discussed. In particular, the advantages of using high specific speed impulse turbines, such as the Turgo Impulse turbine manufactured by Gilbert Gilkes and Gordon, to cover the range of conditions are described.

30158 (TVA/PUB—84/21b, pp 791-802) **Layout, design, erection and operating experience of low head turbines.** Hoeller, H.K., Grein, H.; Hollenstein, M. 1983. NTIS, PC A99/MF A01. File Number DE84008049. (CONF-830939—Vol.2).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

The layout procedure of low head turbines based on extensive model tests is described. It is shown how annual energy production with respect to total investment cost is maximized for a given flow duration curve of a run of the river plant. Various typical designs of low head turbines are presented. Erection procedure and operating experience are commented. It is emphasized that profitability is particularly dependent of the turbine type and the design of the turbine. Inlet and civil engineering structure upstream of the intake should be based on model tests.

30159 (TVA/PUB—84/21b, pp 803-812) **Effect of increased dimensions on the design and manufacture of water turbines.** Casacci, S.; Caillot, G.; Wegner, M. 1983. NTIS, PC A99/MF A01. File Number DE84008049. (CONF-830939—Vol.2).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

In the field of big hydroelectric schemes, cost-saving considerations lead the customers and manufacturers to contemplate ever-increasing unit outputs. Over the past 20 years, the output of medium-head Francis turbines has increased from 200 MW to 800 MW. Design and manufacture of such giant turbines cannot be based on a mere extrapolation or similarity study from the units already in service. From the hydraulic and mechanical design of the manufacturing process, the the manufacturers must solve new problems specific to these widely-sized machines while reducing their overall cost and increasing their efficiency.

30160 (TVA/PUB—84/21b, pp 813-821) **Gears for hydro bulb turbines, 10-100 MW, and station design.** Cederberg, B. (Stal-Laval Turbin AB, Finspong, Sweden). 1983. NTIS, PC A99/MF A01. File Number DE84008049. (CONF-830939—Vol.2).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

The geared bulb design has established its feasibility for higher powers by the Avesta plant, 2 x 14 MW, commissioned 1982, and the Sidney A. Murray Jr. Station, 8 x 24 MW, now being contracted. In the range 10-100 MW and for heads up to 13-15 m the geared bulb unit is cheaper, has a higher efficiency and a better unit availability than conventional designs. Presently 600 rpm generators are used, but by using a new type of coupling standardized design of 900-1200 rpm generators can be used in the near future. Geared bulb units permit a new design of dam and power house to be used. Power plant costs can be cut by 10-25% by using geared bulb units.

30161 (TVA/PUB—84/21b, pp 822-831) **Hydro generators for low-head applications.** Ferguson, J.H. (Canadian General Electric, Peterborough, Ontario). 1983. NTIS, PC A99/MF A01. File Number DE84008049. (CONF-830939—Vol.2).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

Low-head hydro applications may have a different arrangement of the generating equipment than the familiar vertical-axis configuration used with conventional hydro generators. The reasons for these differences are reviewed and the horizontal-axis arrangements of both the bulb and straight-flow turbines are described. The characteristics of the generators for these arrangements are discussed using two recently installed generators as examples: the 18.2 MV.A bulb-type generator for St. Mary's and the 19.1 MV.A rim-type generator for Annapolis Royal.

30162 (TVA/PUB—84/21b, pp 841-850) **Modern use of computers in the design, analysis and manufacture of hydraulic turbine runners.** McNabb, J.Y. (Dominion Engineering Works Ltd., Montreal, Quebec). 1983. NTIS, PC A99/MF A01. File Number DE84008049. (CONF-830939—Vol.2).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

Hydraulic turbines are highly efficient machines. Much of that depends upon being able to properly design and accurately manufacture the runner. Recent developments in the use of computers have revolutionized the way these tasks are performed and the quality of the resulting product. A description is given of a system of computer programs which have been developed to efficiently perform the following tasks: interactive graphics blade design, finite element 3-dimensional fluid flow analysis, 3-dimensional structural stress analysis, 5-axis N.C. machining of both model and full-sized runner blades.

30163 (TVA/PUB—84/21b, pp 881-890) **Jonghua Dam Project.** Cheng, R.Y.; Hsu, R.L.; Chen, C.C. 1983. NTIS, PC A99/MF A01. File Number DE84008049. (CONF-830939—Vol.2).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

The 82 m high Jonghua Dam is originally designed for silt control as a part of the Integrated Soil Conservation Plan for the Shihmen Reservoir. However, due to the abundance of the stream flow and the steep slope of the river bed at the damsite, it was found that it would be very beneficial to include hydropower generation as one of the functions of the project. The results of a financial analysis showed that the loans to be incurred to finance this project could be repaid over a short period of 12 years. Implementation of the Jonghua Dam Project has not only brought about the maximum exploitation of water resources but also will ensure the provision of a reliable source of revenue which may be used to finance the soil conservation work of the catchment area of a reservoir.

30164 (TVA/PUB—84/21b, pp 892-897) **Hoover Powerplant uprating.** Hamann, B.D. (Bureau of Reclamation, Boulder City, NV). 1983. NTIS, PC A99/MF A01. File Number DE84008049. (CONF-830939—Vol.2).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

Hoover Dam is located on the Colorado River about 35 miles southeast of Las Vegas, Nevada. The first of the 17 generators began commercial operation in 1936. Since the plant is approaching the half century point in age, much equipment is in need of major rehabilitation. Analysis indicates that the plant can be rehabilitated and uprated from the original nameplate capacity of 1,344,000 kilowatts (kW) to about 1,818,000 kW with a replacement cost component of about $49,000,000 and an uprating cost component of about $47,000,000 for a total of about $96,000,000. The new capacity would be used for power system peaking, thereby displacing combustion turbine fuels. Obtaining the uprating - that is, capital investment - funds will require legislation and resolution of certain issues of entitlement to the Hoover resource.

30165 (TVA/PUB—84/21b, pp 898-903) **Feasibility of turbine modernization at TVA's Pickwick Landing Project.** Adams, J.S. 1983. NTIS, PC A99/MF A01. File Number DE84008049. (CONF-830939—Vol.2).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

The advancement of hydro turbine technology has made it financially attractive in some cases to replace older turbine runners, even before the end of their useful lives, with new more efficient and powerful machinery. An example of a plant which has excellent potential for modernization is the Pickwick Landing Project owned by the Tennessee Valley Authority. Located on the Tennessee River in Hardin County, Tennessee, it is a multipurpose project which includes a powerhouse containing six hydroelectric generating units. The total generator nameplate capacity is 220,040 kW. Although the six units are identical in size, units 1 through 4 were installed between 1938 and 1942, while units 5 and 6 were installed in 1952 and have runners of more modern design. Field tests of the newer units showed turbine outputs approximately 15% greater than the older units. Turbine performance data obtained from turbine manufacturers for potential replacement runners indicated that significant gains in capacity and energy were indeed possible for units 1 through 4. Units 5 and 6 do not appear to warrant renovation at this time. For use in the investigation of the feasibility of runner replacement, a computer model was developed to simulate the plants power production before and after turbine modernization. It was estimated that new runners would increase the effective plant capability by about 18 MW and the average annual generation by about 100,000 MWh. The total project cost attributable to replacing the turbine runners was estimated to the $16.3 million in present worth 1986 dollars. Benefits from the expected additional power generation were valued between $39.8 million and $69.6 million in present worth 1986 dollars, based on various economic forecasts.

30166 (TVA/PUB—84/21b, pp 904-911) **Chief Joseph 1-16 uprate and modernization.** Bryan, K.A. (Army Corps of Engineers, Portland, OR). 1983. NTIS, PC A99/MF A01. File Number DE84008049. (CONF-830939—Vol.2).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

The first 16 generating units and associated major electrical equipment at Chief Joseph Dam are currently being uprated and modernized. This program is being undertaken to utilize the additional energy available due to increasing the power pool elevation and to meet the Northwest Power Pool system requirements. The different alternatives examined in the modernization/uprating process and a brief overview of the final approach taken are looked at. In particular the generators, governors, transformers, main unit exciters, power circuit breakers and station service generators are discussed along with the methods used for completing the work in as short a time as possible.

30167 (TVA/PUB—84/21b, pp 912-920) **Renovation of the Lloyd Shoals hydro excitation system.** Schaefer, R.C.; Meissel, S.M. (Basler Electric, Highland, IL). 1983. NTIS, PC A99/MF A01. File Number DE84008049. (CONF-830939—Vol.2).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

A renovation project involving the excitation system used in an early built hydroelectric generating plant is discussed. Various approaches for restoring and upgrading the faulty excitation system are reviewed. First, an examination is made of the different types of exciters and their characteristics. Secondly, a review is made of the equipment cost, reliability, maintenance, and projected long range cost savings between systems. Finally, the numerous benefits that were achieved upon the installation of the solid state static excitation systems are outlined.

30168 (TVA/PUB—84/21b, pp 921-930) **Underwater explosives detonations and structural responses, Guri Hydro Project, Venezuela.** Oriard, L.L. (Lewis L. Oriard, Inc., Huntington Beach, CA). 1983. NTIS, PC A99/MF A01. File Number DE84008049. (CONF-830939—Vol.2).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

Completion of the 10-unit first-stage powerhouse at Guri Dam, Venezuela, required the removal of a large pinnacle of rock which remained in the river bed under 70 ft. of water directly in front of the powerhouse walls at the location of the last three generating units. It had been assumed originally that explosives could not be used for removing the pinnacle because underwater shock pressures would greatly exceed the static pressures the powerhouse was designed to withstand. Consequently, a plan had been developed for rock removal by mechanical methods. However, as the mechanical work began, it became evident that mechanical rock removal would be far more difficult than originally assumed, that the time estimate of 3 to 3 1/2 years to remove the rock mechanically would be exceeded greatly, and that it might even prove impossible in this depth of water, in which visibility was near zero. The feasibility of using explosives was assessed and, a plan which would remove the rock while leaving the powerhouse undamaged was developed. Considering the cost of lost electrical revenues for an indeterminate number of years, it was deemed essential that a full assessment should be made of the feasibility of using explosives. The plan and its implementation are discussed.

30169 (TVA/PUB—84/21b, pp 931-940) **Rehabilitation of TVA's Ocoee No. 2 Project.** Buttrey, H.C. (Tennessee Valley Authority, Knoxville). 1983. NTIS, PC A99/MF A01. File Number DE84008049. (CONF-830939—Vol.2).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

TVA's Ocoee No. 2 Project is a minimum reservoir, high head operation, consisting of a timber crib dam, a forebay siphon spillway section, and nearly five miles of open wooden flume connecting to its powerhouse. The project contains several unique and historical features. The wooden flumes is believed to be the largest such structure in the country and one of the oldest. The siphon spillway, a European invention, is believed to have made its debut in America at Ocoee No. 2. Power generation was suspended in 1976 due to deterioration of several steel and concrete trestles supporting portions of the wooden flume. Other deterioration included portions of the flume and the downstream face of the timber crib dam. Several alternatives were subsequently studied for rehabilitating the project. These studies resulted in a decision to replace several badly deteriorated steel and concrete trestles, strengthening the wood crib dam, and replacing the entire 4.6-mile wooden flume. The recreational potential of the river is also discussed. When water is not diverted through the flume, it is spilled over the wood crib dam, creating a premier whitewater recreation stream. In order to allow recreational use of the river, a decision was made to interrupt power generation and divert flow down the river for approximately 82 days a year.

30170 (TVA/PUB—84/21b, pp 941-948) **Simulation of the Niagara Hydroelectric Project.** Dowler, C.; Gosset, C.; Hamill, T. (New York Power Authority). 1983. NTIS, PC A99/MF A01. File Number DE84008049. (CONF-830939—Vol.2).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

The development of a simulation model for a large hydroelectric plant, the Niagara Power Project, is described. The Niagara Project is operated as a combined run of river and pumped storage system, so the simulation must incorporate both of these operating modes. Hydrology, hydraulics, generation, and plant operations are simulated with a new computer model and used to determine changes in energy production resulting from proposed changes at the Project.

30171 (TVA/PUB—84/21b, pp 949-958) **Multiple use issues and the reactivation of former hydro plants.** Kauffman, J. (Norris and May, Inc., Ann Arbor, MI). 1983. NTIS, PC A99/MF A01. File Number DE84008049. (CONF-830939—Vol.2).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

Many proposed hydro projects involve former hydro plants and impoundments presently used for recreation, lake level maintenance, water supply or flood control. Conflicts between hydro project developers and other users of a dam or water resource may arise and result in costly delays, or in extreme cases, abandonment of hydro projects. However, some developers have been able to successfully accommodate existing or proposed uses into hydro plant design and operation. Case studies are used to demonstrate how multiple uses can be accommodated into the design and operation of hydroelectric facilities. Historical background is used to provide insight into the development and resolution of environmental conflicts.

30172 (TVA/PUB—84/21b, pp 959-966) **New technology for modernization of existing hydraulic turbines.** Itoh, H. 1983. NTIS, PC A99/MF A01. File Number DE84008049. (CONF-830939—Vol.2).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

The modernization and the rehabilitation of the existing hydraulic turbines are one of the most effective means to produce the additional electric power in the shortest possible time. The rehabilitation of the existing units has only been thought of as the recovery to the original turbine conditions. It is clear that the upgrading, such as the improvement of the performance, function, reliability and the easy maintenance, is required. The endeavors for the hydro-engineering developments and their applications of the new techniques are discussed.

30173 (TVA/PUB—84/21b, pp 967-975) **Increasing the capabilities of hydroelectric systems.** Wall, R.L. (General Electric Co., Schenectady, NY). 1983. NTIS, PC A99/MF A01. File Number DE84008049. (CONF-830939—Vol.2).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

Considerable attention is being directed toward increasing hydroelectric generating capacity by installing generating equipment at existing water control dams, developing new dams and restoring old sites. This is as it should be, but uprating existing systems should play an important role in increasing total hydroelectric generating capacity. Increasing the capability of an existing hydroelectric system means increasing its capacity to generate electrical energy above the original design. It can also mean restoring the capacity of a system to its original level after it has deteriorated due to inadequate maintenance. The equipment changes necessary to accomplish either of these objectives generally produce the added benefits of improved reliability and decreased operating and maintenance costs.

30174 (TVA/PUB—84/21b, pp 976-985) **Conversion of mechanical governors to electrical governors.** Elliott, J.M. (Woodward Governor Co., Rockford, IL). 1983. NTIS, PC A99/MF A01. File Number DE84008049. (CONF-830939—Vol.2).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

Mechanical hydraulic governors manufactured by Woodward for the purpose of controlling water driven turbines, where properly maintained, are operating equally as well today as when they were first installed. Due to new technology, especially in solid state devices, changes in methods of operation, and requirements from the utilities, there is often a need for changes in the capabilities of governing equipment. Electric hydraulic governors are not necessarily essential for all governor applications. The operating requirements include the capability for the governor to respond to actual power output of the generator (referred to as load feedback), quicker response for better stability during synchronization and the ability of regulating station joint load control. When a mechanical hydraulic governor is converted to an electrical hydraulic governor, usually only a small portion of the existing governor necessitates replacing. To minimize the actual down time for converting the governing equipment, it is essential for all parties concerned to be well versed in the desired operating requirements for a given project. Through coordination and proper planning, the governor conversion can usually be accomplished with ease. Normally, governors for hydro turbines are specifically designed and custom built to meet the requirements for a particular project. Therefore, to effectively conduct an accurate cost analysis for conversion of an existing governor, one must carefully review all facets of operation. As can be imagined, the more elaborate the control requirements, the greater the dollar cost.

30175 (TVA/PUB—84/21b, pp 986-996) **Case studies in hydroelectric turbine rehabilitation.** Ernst, L.R. (Allis-Chalmers Corp., York, PA). 1983. NTIS, PC A99/MF A01. File Number DE84008049. (CONF-830939—Vol.2).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

Rehabilitating hydroelectric generating equipment will maintain high performance and, in many cases, can increase energy output. The energy output of existing hydraulic turbines can be increased by applying modern technology and materials to upgrade performance. The generator performance can frequently be improved as well. Some of the benefits of repair and rehabilitation are: 1) increasing the output and/or efficiency of the turbine and generator; 2) reducing equipment downtime, both planned and unplanned; 3) extending the service life of existing hydraulic turbine and generator; 4) reducing detrimental operating characteristics such as vibration and cavitation; 5) correcting mechanical problems that could potentially result in a catastrophic failure; 6) quickly repairing damaged units; and 7) restoring abandoned units to produce power. Several typical rehabilitation projects performed by Allis-Chalmers are examined.

30176 (TVA/PUB—84/21b, pp 998-1005) **Computer control and optimization of an industrial hydro-electric system.** Firlotte, P.I.; Cuddy, M.J.; Ziegler, J.E. 1983. NTIS, PC A99/MF A01. File Number DE84008049. (CONF-830939—Vol.2).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

Great Northern Paper Company owns and operates a multiplant hydro-electric system on the West Branch of Maine's Penobscot River. The system consists of 19 dams with a combined storage capacity of 58 billion cubic feet. Six of the dams include hydroelectric generating facilities with installed capacity of 114 MW. About 700,000 MW/yr. of base load power is produced for Great Northern's Millinocket and East Millinocket paper mills. In 1980 Great Northern undertook the design and construction of a computer control system for its' hydro-electric plants. The six plants contain a total of 31 generating units. Francis, Kaplan and fixed blade propeller units are included in the system. To implement the project, Great Northern chose to put together a team of its employees and outside consultants to select and purchase the hardware and design the software for the system. Control is accomplished through a network of Digital Equipment Company (DEC) computers (nine are used in total) operating on the bias adjustment of existing generator governors and voltage regulators. The computer system allows a single centrally located power dispatcher to operate and optimize the performance of the six unmanned stations, covering a 60 mile reach of the river. A unique feature of the system is that the flow of water through each turbine is measured directly, as is the power output of the generators. Thus, machine efficiency can be monitored directly, without use of inferential data. The use of machine efficiency curves and optimization by equal derivatives allows the computer to insure that the power output for each station is the maximum possible for the water flow specified. The system also monitors the electrical production of six high pressure steam turbogenerators (both condensing and reducing), located in two steam plants separated by eight miles. A utility tie is also monitored.

30177 (TVA/PUB—84/21b, pp 1006-1015) **Computer modeling of network of reservoirs and hydroelectric plants.** Sarkar, C.K. (Chas. T. Main, Inc., Boston, MA). 1983. NTIS, PC A99/MF A01. File Number DE84008049. (CONF-830939—Vol.2).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

A general purpose computer model, HYSM (Hydroelectric Simulation), was described at the Waterpower '81 Conference under the title "Mathematical Modeling and Computer Simulation of Cascading System of Hydroelectric Plants." Its original modeling capability was limited to ten cascading reservoirs/plants located on the same river, each plant having not more than ten generating units. Since then the computational procedures of HYSM have been refined and its features and capability greatly enhanced to include simulation of a basin wide network of plants and multipurpose reservoirs with or without hydroelectric generation. During the past two and half years HYSM found extensive applications to a large number of hydroelectric projects of diverse nature, complexities, and requirements in this country and abroad resulting in better and more accurate conclusions with significant savings in time and cost. The enhanced capabilities of HYSM and its applications to four projects of diverse nature, two domestic and two foreign are described.

30178 (TVA/PUB—84/21b, pp 1016-1025) **Experiences with a mathematical hydropower representation.** Giles, J.E.; Wunderlich, W.O. (Tennessee Valley Authority, Norris). 1983. NTIS, PC A99/MF A01. File Number DE84008049. (CONF-830939—Vol.2).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

The development of operating or planning strategies for a power system requires an accurate mathematical representation of its principal components. A power system dominated by thermal units with hydro units contributing toward peak-load reduction is a common configuration and is the basis for the hydropower representation given. A realistic representation of such a hydrothermal power system requires accurate modeling of its physical, economic, and probabilistic aspects. Relationships based on physical laws and empirical data are used to characterize hydro unit performance, such as power output and turbine discharge versus gross head, and thermal unit performance, such as conversion of heat energy to electrical energy versus unit capacity level. Economic considerations, such as fuel cost per increment of heat energy versus heat energy, are usually based on operational experience and projections. A major consideration is the uncertainty about inflow, unit availability, and power demand inherent in power systems operation. Modeling these elements forms the integral part of a procedure for evaluating the hydrothermal system operation cost for a given hydro system schedule. This procedure serves as the hydropower representation in reservoir system scheduling models. The procedure described has been shown to be an efficient, reasonably accurate model for a large hydrothermal power system. It is presently being used as part of a weekly time-step model that aids in planning and scheduling hydropower operations. Experiences with the development and use of this hydropower representation will be discussed.

30179 (TVA/PUB—84/21b, pp 1026-1035) **Forecasting flow for hydroelectric operations.** Crawford, N.H. 1983. NTIS, PC A99/MF A01. File Number DE84008049. (CONF-830939—Vol.2).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

Operating hydroelectric facilities where reservoir storage is available requires decisions on the use of stored energy. More energy can be produced now limiting later production, or less energy can be produced now so that more energy will be available later. Evaluation of the timing of use of stored energy requires data on current generation costs, forecasts of the value of generation in future, and forecasts of future streamflows. The full range of future streamflows needs to be considered: an optimal use of storage for one particular streamflow forecast is not sufficient. Methods for calculation of optimal use of stored energy that consider uncertainty in streamflow forecasts by using the expected value of future streamflows are outlined. Computer based graphics are used to allow system managers to see the sensitivity of the selected hydro operating levels to the basic data and forecasts used the analysis.

30180 (TVA/PUB—84/21b, pp 1036-1045) **TVA's weekly scheduling model: overview and implementation.** Shane, R.M.; Boston, W.T. (Tennessee Valley Authority, Norris). 1983. NTIS, PC A99/MF A01. File Number DE84008049. (CONF-830939—Vol.2).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

The TVA weekly scheduling model is an operational planning model designed to model week-to-week variations in water level, discharge and electrical generation at TVA operated reservoirs. Since the model was first introduced into actual operations by the Office of Power in 1980, it has been used heavily for 1) evaluation of operational impacts to be expected from proposed contractual and operating policy changes, 2) forecasting of hydro system energy utilization and energy-in-storage, and 3) quarterly calculations of hydro system economy guides. Flexibility provided by the model to easily eliminate objectives, add objectives, change the priority of objectives, model the system using any portion of a continuous hydrologic record of inflows beginning in 1903, and then examine operating data using interactive computer graphics has proven to be of great value to Office of Power personnel in all applications.

30181 (TVA/PUB—84/21b, pp 1046-1055) **Indexed sequential modeling of hydropower system operations.** House, P.M.; Ungvari, J.L. (Western Area Power Administration, Golden, CO). 1983. NTIS, PC A99/MF A01. File Number DE84008049. (CONF-830939—Vol.2).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

Indexed Sequential Modeling (ISM) is essentially a simulation of hydropower system operations under all water conditions within an extended historical period that allows probabilisitic analysis of hydropower generation. This modeling approach is currently being used on a selective basis by both the Department of Energy's Western Area Power Administration (Western) and the Department of Interior's Bureau of Reclamation (BuRec) for determining marketable power associated with the Colorado River hydropower system. In principle, the ISM statistical analysis approach is applicable to any river basin system. Western's application of the ISM approach to the Central Valley Project (CVP), a Federal hydropower system in California is discussed. This application consisted of three basic tasks: 1) development of two water operations studies to form the hydrologic data base to be used in the ISM model; 2) modification of Western's existing CVP power generation model for application of the ISM approach; and 3) performing ISM computer runs and analyzing results. Each of these tasks is described. The results of the ISM approach as applied to the CVP were determination of a set of monthly ranges of CVP power outputs and derived probability curves. These results can be used for power marketing and other planning purposes and could represent a basis for marketing additional reliable capacity from the CVP Federal hydropower system. Western's overall conclusion based on its CVP studies is that the ISM approach is technically applicable to the CVP hydropower system for making capacity and energy planning computations that could be used in developing its future power marketing plans.

30182 (TVA/PUB—84/21b, pp 1056-1065) **Computerized optimization of cascading hydropower stations.** Restrepo, P.J.; Goff, K.A. (Stone and Webster Engineering Corp., Boston, MA). 1983. NTIS, PC A99/MF A01. File Number DE84008049. (CONF-830939—Vol.2).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

The small power stations that dominate today's hydroelectric development program in the US are inherently expensive. In the project evaluation process every effort must be made to assess site capacity to determine the maximum power potential of the available head and flow conditions. The evaluation must be essentially the same for an older station undergoing relicensing. Owners must carefully examine a plant's installed capacity and the full energy potential available in the water resource to ensure that it is most efficiently and economically utilized. Factors that influence the energy generation potential of a plant are: 1) equipment selected for new projects or installed in older plant; 2) minimum flow release requirements; 3) operating rules; and 4) the type of plant (e.g., whether a run-of-river facility has ponding capability or a large storage capacity). The owner-developer must explore every generation alternative in the evaluation and development process. The methods and computer tools being used to ensure that available water resources are used most efficiently at project sites being developed, rehabilitated, or relicensed are described.

30183 (TVA/PUB—84/21b, pp 1066-1074) **Re-regulating storage in water supply-hydroelectric projects.** Neill, G.V.; Henderson, D.I. 1983. NTIS, PC A99/MF A01. File Number DE84008049. (CONF-830939—Vol.2).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

The benefits of a hydropower facility integrated in a municipal water supply system can be increased by including re-regulating storage. Both the amount and the value of the energy produced are increased. Re-regulating storage allows the hydropower to be used as high value peaking capacity while maintaining the integrity and operation of the water supply system. Recent experience is discussed and the design and analysis procedure of an integrated water supply-water power development are described. The constraints, design optimization, and benefits of the integrated facility with re-regulating storage are discussed.

30184 (TVA/PUB—84/21b, pp 1075-1082) **Automation of small scale hydroelectric generating plants.** Bergseng, J. 1983. NTIS, PC A99/MF A01. File Number DE84008049. (CONF-830939—Vol.2).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

For economic operation of small hydroelectrics, a high level of automation is frequently used. Rising labor costs mean that inspection must be kept to a minimum. Local conditions - such as availability of personnel, access to the power plant, the size of its reservoir, its importance as grid supplier - all influence the degree of automation. Protection is not to be taken as a part of automation. Protection must put the station in a safe condition when a fault is present. Normally, this will entail bringing the power plant to a standstill. Protection is therefore a functionally independent system and is not considered.

30185 (TVA/PUB—84/21b, pp 1083-1092) **Acoustic flowmeters for hydro-turbine efficiency measurement.** Lowell, F.C. Jr.; Dube, L. (Ferranti O.R.E., Inc., Falmouth, MA). 1983. NTIS, PC A99/MF A01. File Number DE84008049. (CONF-830939—Vol.2).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

On-line, real time efficiency measurement of hydroelectric turbine generators has been accomplished using an integrated system which combines a multipath acoustic flowmeter installed in several turbine penstocks, pressure sensors and power meter. Results include relative efficiency of two units compared to the thermodynamic method and model test data.

30186 (TVA/PUB—84/21b, pp 1093-1099) **Economical control of hydroelectric plants.** Butz, H.; Lund, K.; Radvani, T. 1983. NTIS, PC A99/MF A01. File Number DE84008049. (CONF-830939—Vol.2).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

Hydroelectric plants benefit substantially from modern control techniques and equipment. Some of the ways computer control systems maximize profits in hydroelectric plants are described. Modern control systems include some programmable control devices. The use of programmable controllers or computers on small scale hydro projects is required to optimize profitability. The use of a modular intelligent controller makes upward and downward expansion possible. With this expansion, cost saving control features can be implemented. Additionally, replacing other equipment, minimizing labor, simplifying installation, and developing a control hierarchy are also discussed.

30187 (TVA/PUB—84/21b, pp 1100-1108) **Missouri River Power Plants Control System.** Trout, J.E. (Corps of Engineers, Omaha, NE). 1983. NTIS, PC A99/MF A01. File Number DE84008049. (CONF-830939—Vol.2).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

The Missouri River Power Plants Control System (MRPPCS) is a computer based supervisory control and data acquisition system for controlling six hydro-electric power plants on the upper Missouri River. The system will consist of a master control station designated Regional Hydropower Action Center (REHAC) and six Power Plant Control Systems (PPCS). The power plants are spread over 3 states (South Dakota, North Dakota, and Montana) and 700 miles of the upper Missouri River. Total generation capacity of the six power plants is 2429MW.

30188 (TVA/PUB—84/21b, pp 1109-1118) **Special features of cascade operation of Chibro and Khodri Power Stations on the Yamuna River in India.** Agrawal, T.C.; Rikh, V.N.; Gupta, A.K.; Tandon, G.L. (Hydro Electric Projects, Dehradun, India). 1983. NTIS, PC A99/MF A01. File Number DE84008049. (CONF-830939—Vol.2).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

The scheme consists of an underground hydropower station at Chibro (4 x 60 MW) which receives water through a 6.2-km-long pressure tunnel from the headworks at Ichari on the Tons River (a tributary of the Yamuna River) and discharges the same into a collection gallery from where another pressure tunnel of 6 km in length takes off for feeding a surface power station at Khodri (4 x 30 MW), with its tailrace discharging water back into the Yamuna River. The scheme is unique because of insignificant storage available in the collection gallery being equivalent to less than two minutes of full load discharge of Khodri. This has caused a very challenging problem of keeping the collection gallery level practically constant not only during steady-state operating conditions but also during sudden load rejection/acceptance due to tripping of machines or system disturbances. The narrow margin of the operating level available in the collection gallery requires complete matching of water flow between two power stations connected by a long closed water conductor system almost instant by instant. Any excess water drawn by the downstream power station will result in a fall of the collection gallery level of an upstream power station which, if not arrested, will result in air entering the headrace tunnel of Khodri with possible danger to tunnel lining and hydro turbines. Likewise, if the downstream power station draws less water than that released by the upstream power station, it will result in spilling of water from the Chibro collection gallery, causing generation loss. A scheme was devised for the operation of these two power stations in tandem which incorporates special constructional and control features. Various challenging problems anticipated in this unique scheme are described along with their solutions.

30189 (TVA/PUB—84/21b, pp 1119-1128) **Optimizing operating efficiency at Hoover Powerplant.** Stitt, S.C. (Bureau of Reclamation, Denver, CO). 1983. NTIS, PC A99/MF A01. File Number DE84008049. (CONF-830939—Vol.2).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

Plant efficiency gains that could be realized at Hoover Powerplant by the use of an algorithm to optimize plant efficiency are given. Comparisons are shown between the present plant operating conditions modeled on a digital computer, and the plant with the proposed unified bus operating under control of a GELA (Generator Efficiency Loading Algorithm) system. The basic concepts of that algorithm are given.

30190 (TVA/PUB—84/21b, pp 1129-1139) **Optimizing frequency regulation of isolated hydroelectric projects.** Carson, P.T. (R.W. Beck and Associates, Seattle, WA). 1983. NTIS, PC A99/MF A01. File Number DE84008049. (CONF-830939—Vol.2).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

Completion of the 22.5-MW Swan Lake Hydroelectric Project near Ketchikan, Alaska will result in the isolated Ketchikan area electrical system being supplied on a regular basis only from hydroelectric power stations. The frequency regulating characteristics of the existing system's hydroelectric units is very poor. Therefore, the decision was made during the Swan Lake Project design to improve its frequency regulation capabilities to enhance the combined system's performance. Minimum levels of regulation performance as required by the system's loads and as recommended by NEMA standard HT4-1958 were selected as goals in the work. Five alternatives for achieving this were considered and compared using a programmable calculator model to predict the project's frequency vs. time performance. To confirm the selected group of alternatives and to predict the ultimate system frequency regulation, an analog computer model was utilized to simulate the combined operation of the four hydroelectric plants which will comprise the system. A comparison of the actual regulating characteristics and the predicted values for a similar project constructed in 1982 are presented. Difficulties overcome during this project's startup and initial operation which affected its frequency regulation are discussed.

30191 (TVA/PUB—84/21b, pp 1140-1148) **Equipment selection and operation policy aided by micro-computer.** Wood, D.W.; Turner, H. Jr.; Horn, D.R. (Anderson-Nichols and Company, Inc., Boston, MA). 1983. NTIS, PC A99/MF A01. File Number DE84008049. (CONF-830939—Vol.2).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

Two large dams in series on the West Branch Farmington River in Connecticut are under design to be retrofitted for hydropower. The dams built for water supply, flood control, and low flow augmentation have a complex set of operating constraints, and the headwater of the lower dam is the tail water of the upper dam. The selection of turbines was dependent on the assumptions made for operating policy of the two dams. In order to conveniently test various combinations of equipment and operating policy, a power generation simulation model was developed on a micro-computer. The potential for using the model as a decision support system to aid in the scheduling of releases is also under consideration.

30192 (TVA/PUB—84/21c, pp 1355-1365) **EPRI's hydro R and D program.** Sullivan, C.; Birk, J.; Ferreira, T. (Electric Power Research Institute, Palo Alto, CA). 1983. NTIS, PC A20/MF A01. File Number DE84007687. (CONF-830939—Vol.3).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

Hydroelectric power development and improvement have been receiving increased attention due to the increasing value of electricity and importance of renewable energy. In 1981 EPRI established a research program focused on small-hydro cost reduction and incremental performance improvement of large hydro. The current needs as specified by the industry are to: establish causes and methods for reducing forced outages, reduce frequency of scheduled outages, improve new equipment availability/reliability, reduce environmental and safety concerns at minimum cost, develop a low cost modular component package for small hydro and, specify planning procedures that recognize load following, system regulation and spinning reserve. Key research projects currently underway to address these needs are: evaluating cavitation problems and repair procedures, developing diagnostic tools for assessing turbine and generator status, developing and demonstrating cost effective modular small hydro equipment packages, publishing a complete series of practical manuals on hydroelectric generation, and assisting in the publication of a North American periodical on hydroelectric generation.

30193 (TVA/PUB—84/21c, pp 1386-1393) **St. Anthony Falls Hydraulic Laboratory turbine test facility.** Wetzel, J.M.; Arndt, R.E.A.; Bintz, D.W. (Univ. of Minnesota, Minneapolis). 1983. NTIS, PC A20/MF A01. File Number DE84007687. (CONF-830939—Vol.3).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

With the renewed interest in low head hydropower, attention is naturally directed towards the development of small, low cost turbines. The major turbine manufacturers have recognized this need, and several smaller suppliers have also been stimulated to introduce new products. A turbine test stand to be used for testing model hydroturbine units and for more basic hydroturbine research is presently being installed at the Laboratory as a permanent facility. The facility is scheduled for completion shortly and will be the only independent turbine test facility in the US available for sponsored studies. The facility consists of a closed test loop with a 300 HP main pump and motor. The arrangement of the head and tail-tanks will accommodate a variety of turbine configurations. A 100 HP dynamometer is available, and the test loop is designed for testing either pumps or turbines. Pressure control is provided to permit testing under cavitation conditions. The facility will make use of the Laboratory's computer system for data processing. It is anticipated that potential uses of the facility will include research on new turbine concepts, intake and outlet design, model tests for small manufacturers, cooperative research with turbine manufacturers, acceptance tests, and the training of hydropower engineers. The availability of the facility for conducting basic research with results published in the open literature is considered unique, and complements the Laboratory's extensive experience in cavitation research and other related areas in hydropower development.

30194 (TVA/PUB—84/21c, pp 1394-1402) **Optimization of a diffuse/ejector for ultra low-head systems.** Moses, H.L.; Siegel, R.P.; Brown, E.F. (Virginia Polytechnic Institute and State Univ., Blacksburg). 1983. NTIS, PC A20/MF A01. File Number DE84007687. (CONF-830939—Vol.3).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

An investigation of head augmentation for ultra low-head hydroelectric systems by use of an ejector in the diffuser, or draft tube, is described. A detailed analytical and experimental study of flow in the ejector, which consisted of a conical diffuser with a peripheral wall jet, was conducted. Based on these results, an overall system analysis was developed and compared with experimental results from a small, axial-flow turbine. Finally, a brief economic analysis was made to determine the advantage, if any, of the ejector system.

30195 (TVA/PUB—84/21c, pp 1403-1407) **New approach to ULH development using the cross-flow turbine.** Johnson, W.F.; Ely, R. III; White, F. (New Found Power Co., Inc., Hope Valley, RI). 1983. NTIS, PC A20/MF A01. File Number DE84007687. (CONF-830939—Vol.3).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

A Cooperative Research Program funded jointly by New Found Power Co. of Hope Valley, RI and the DOE Idaho Operations Office in 1980-81 resulted in both an optimized geometry for ultra-low-head turbines of the Cross-flow (or Mitchell-Banki) type and low cost construction materials and techniques. Model tests were performed on a wide variety of possible nozzle shapes at the University of Rhode Island Hydraulics Lab. Tests were performed to confirm the applicability of draft tubes to the Cross-flow turbine. Results of the tests are presented.

30196 (TVA/PUB—84/21c, pp 1418-1427) **Pump station conversion.** Stern, P.S. (Colorado Project/TIP, Inc., Boulder). 1983. NTIS, PC A20/MF A01. File Number DE84007687. (CONF-830939—Vol.3).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

The feasibility of converting an existing pump station to reversible power generation in the water distribution system of the City of Boulder, Colorado was studied. Two pumping stations in the eastern most portion of the City's water system remain idle a good portion of the year with water flowing by them from the main gravity system. During the summer months, the stations are used to pump treated water from a secondary source into the system. Water flows averaged 1.7 to 3.5 cfs past the pumps during off-season. Sufficient flow exists to convert one of the three 125 hp pumps at one of the stations for power generation. Approximately $10,000 is required to convert the existing pump for reversible operation equivalent to a 58KW turbine capable of generating approximately 140,0000 KW-hours annually. Power would be sold to Public Service Company of Colorado. Conversion consists of minor modifications to existing equipment and the addition of some simple electronic gear. A demonstration project in conjunction with the local school district is considered due to the close proximity of the station to an existing education facility.

30197 (TVA/PUB—84/21c, pp 1428-1437) **Cherepnov water lifter - a direct use of hydropower to pump water.** Liu, H.; Fessehaye, M.; Geekie, R. (Univ. of Missouri, Columbia). 1983. NTIS, PC A20/MF A01. File Number DE84007687. (CONF-830939—Vol.3).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

Under the sponsorship of the US Department of Energy, the University of Missouri, Columbia has recently completed research to assess and develop the Cherepnov water lifter for use at hydropower sites - especially low-head sites. The Cherepnov lifter is a simple device that extracts the potential energy of water to lift or pump water without having to convert the extracted energy into electricity. As a result, water can be pumped at a cost lower than that of using conventional pumps driven by electrical motors or diesel engines. Economical use of the lifter is not limited to remote locations or developing nations.

30198 (TVA/PUB—84/21c, pp 1438-1446) **Hydrogen production at low-head hydropower plants.** Tarnay, D.S. (Federal Energy Regulatory Commission, Washington, DC). 1983. NTIS, PC A20/MF A01. File Number DE84007687. (CONF-830939—Vol.3).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

The technical and economical feasibility of the conversion of water to hydrogen at low-head hydropower plants and then conversion of hydrogen to electricity via a gas turbine is evaluated. The energy produced in the off-peak or no-demand time, and in time of huge river flows, can be stored in the form of hydrogen, and later, when the on-peak energy is needed, the hydrogen converted to electricity. One of the advantages of this system is that the resource for production of hydrogen - water - is available at the site. It appears that the conversion of waterpower energy at low-head hydropower plants to hydrogen, and its utilization directly at the site, is technically and economically feasible and would improve the economy of the project.

30199 (TVA/PUB—84/21c, pp 1447-1456) **Advanced computerized technique for hydraulic design and optimization of turbines.** Chacour, S.A.; Fisher, R.K.; Colwill, W.H. (Allis-Chalmers Fluid Products Co., York, PA). 1983. NTIS, PC A20/MF A01. File Number DE84007687. (CONF-830939—Vol.3).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

Significant advances in hydraulic design have occurred over the years for all turbine types. These advances were traditionally the results of a slow process of model test development and evaluation of operational experience. In the 1970's, an incremental gain of 0.2% was typically attained for each redesign. Today, new computerized analysis techniques which have been integrated into a computer-aided design and manufacturing system are predicting accurately the complex behavior of fluid flow and are yielding new designs demonstrating significantly greater improvements in efficiency and cavitation performance. The key elements of this system are discussed and how these elements are integrated to form an effective tool is discussed.

30200 (TVA/PUB—84/21c, pp 1457-1466) **Effect of tailrace geometry on draft tube surging.** Nystrom, J.B.; Bozoian, P.M. (Worcester Polytechnic Institute, MA). 1983. NTIS, PC A20/MF A01. File Number DE84007687. (CONF-830939—Vol.3).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

An experimental investigation was undertaken to determine the effects of tailwater geometry on draft tube pressure fluctuations (surging) due to residual angular momentum (vortex breakdown). A test facility using air as the working fluid was constructed using a multi-vane swirl generator to simulate the turbine at off-peak operating conditions. Several simplified geometry draft tubes and a model of an actual draft tube were tested. Tailrace geometry was found to affect neither the magnitude nor the frequency of the pressure fluctuations when the Reynolds number was above a critical value and the ratio of the surge frequency to the first harmonic of the natural frequency of the system was much less than 1. For surge frequencies approaching the natural frequency, the magnitude of the pressure fluctuation was amplified, but the frequency was unaffected. Investigation of the frequency response of the system indicated that the tailrace geometry affected the system response. Likewise, the upstream boundary condition, the swirl generator setting, had an effect on the system response. Modeling criteria were established to predict the effects of resonance due to scale and working fluid. It was shown that models using air cannot correctly simulate the effects of resonance and surging simultaneously for prototype systems using water.

30201 (TVA/PUB—84/21c, pp 1467-1471) **Model development of energy dissipator for Howell-Bunger valve.** Rudavsky, A.B. (Hydro Research Science, Santa Clara, CA). 1983. NTIS, PC A20/MF A01. File Number DE84007687. (CONF-830939—Vol.3).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

The development of an energy dissipator for a Howell-Bunger (H-B) valve is described. The H-B valve is a critical component in many hydroelectric power plants. This study is based on a recent project conducted by Hydro Research Science to optimize the hydraulic effectiveness of several key components of the proposed outlet works for a hydroelectric project in California. One of those components was an H-B valve's energy dissipator, which was required to operate satisfactorily under the project's power-generation operational mode. The course of the experimental program, which produced an effective H-B valve energy dissipator, is outlined. A 1:24 scale model of the H-B valve energy dissipator, the plenum structure, and the power take-off conduit was subjected to anticipated hydraulic conditions. A major objective of the test program was to reduce the high-velocity jet leaving the H-B valve. The types of structural modifications that can be introduced to alleviate turbulent outflow conditions in the exit area are reviewed. Based on the test program, the practicality of model-aired design as an engineering technique to assist project planners is presented.

30202 (TVA/PUB—84/21c, pp 1472-1483) **Guidelines for intake without free surface vortices.** Gulliver, J.S.; Rindels, A.; Lindblom, K.C. (Univ. of Minnesota, Minneapolis). 1983. NTIS, PC A20/MF A01. File Number DE84007687. (CONF-830939—Vol.3).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

Free surface vortices at plant intake can cause excessive vibration, efficiency loss, structural damage, and flow reduction in hydroelectric facilities. They can also be a safety hazard and a potential loss of life. One of the major problems encountered during intake design is the specification of submergence and other design parameters in order to avoid strong free surface vortex formation. In order to assist in preliminary intake design, a plot of dimensionless submergence versus intake Froude number is presented for a number of vertical and horizontal intakes from both field and laboratory observations. The pilot is divided into two regions: (1) a region where intake vortices are unlikely and a model study is not required except with extremely poor approach conditions, and (2) a region with a good possibility of intake vortices, and a model study is recommended. Region 2, where intake vortices are a good possibility, is very large, encompassing many hydropower facilities. This is because minimum intake submergence to avoid vortex formation is highly dependent upon approach conditions, which are site specific. An experimental study was undertaken which focused upon typical intake approach conditions. Most hydropower intakes have a forebay to avoid high circulation near the intake, so the experimental study simulated approach conditions with a forebay or approach channel of varying length and width.

1304 Regulations And Licensing

REFER ALSO TO CITATION(S) 30094, 30106, 30213

30203 (CONF-7907129—, pp 111-122) **Federal jurisdiction in the development of small-scale hydro.** Corso, R.A. (Federal Energy Regulatory Commission, Washington, DC). May 1980. NTIS, PC A11/MF A01. File Number DE84005144.

From UCLA small-scale hydro resources development western regional workshop; Pomona, CA, USA (30 Jul 1979).

The role of the federal government in regulating the development of small-scale hydroelectric resources is discussed. These regulatory powers are administered by the Federal Energy Regulatory Commission (FERC). It is the objective of the FERC to assure that the burden of obtaining a federal license is not time consuming or costly.

30204 (CONF-7907129—, pp 145-148) **Outline of basic issues in small scale hydroelectric development.** Brown, P.W. (Energy Law Institute, Concord, NH). May 1980. NTIS, PC A11/MF A01. File Number DE84005144.

From UCLA small-scale hydro resources development western regional workshop; Pomona, CA, USA (30 Jul 1979).

An outline is presented that sets forth in brief form the major federal and state regulatory issues and institutional, economic and environmental problems confronting small dam development in the Northeastern US. For a fuller treatment of these issues the reader should consult the various reports of the Energy Law Institute of Franklin Pierce Law Center on small scale hydroelectric power.

30205 (TVA/PUB—84/21a, pp 406-414) **FERC cases on municipal hydroelectric development.** Olson, R.A. (ELI Corp., Concord, NH). 1983. NTIS, PC A24/MF A01. File Number DE84007682. (CONF-830939—Vol.1).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

The rulings of the Federal Energy Regulatory Commission in the area of municipal hydroelectric development are examined. The issues discussed include what constitutes a municipality under the terms of Section 3(7) of the Federal Power Act, hybrid and hidden hybrid applications and their eligibility for the municipal preference under Section 7(a) of the Act and loss of the preference due to technical filing requirements of the Commission.

30206 (TVA/PUB—84/21a, pp 415-423) **Battle for municipal preference.** Angyal, R.S. (Federal Energy Regulatory Commission, Washington, DC). 1983. NTIS, PC A24/MF A01. File Number DE84007682. (CONF-830939—Vol.1).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

As hydropower becomes increasingly attractive, for a variety of reasons, the demand for economically attractive sites has multiplied. The Federal Energy Regulatory Commission determines who gets preliminary permits and licenses for new sites, and who gets licenses when existing ones expire. Because it acts as the tie-breaker, the preference given by the Federal Power Act to municipalities has assumed great importance at both these stages. FERC is taking steps to solve problems that may be caused by hybrid applicants improperly attempting to get the benefit of the preference. FERC also has pending before it the appeal of the first initial decision on relicensing awarding a license on the basis of the preference.

30207 (TVA/PUB—84/21a, pp 424-433) **Law, hydropower development, and the American Indian.** Du Bey, R.A; Schlosser, T.P. (Ziontz, Pirtle, Morisset, Ernstoff & Chestnut, Seattle, WA). 1983. NTIS, PC A24/MF A01. File Number DE84007682. (CONF-830939—Vol.1).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

The role of Indian Governments has long been ignored by the federal government in the formulation of national goals and objectives for hydropower development. This has damaged the relationship between Indian tribes and the Government and negatively affected the relationship between Indian tribes and non-federal project proponents. In certain instances the absence of consultation between tribes and hydro project proponents has made it difficult or impossible for hydropower development to take place. In the US, Indian tribes have unique ownership rights in land and water resources which are entitled to special protection. Moreover, the existence of a trust relationship between the Government and Indian tribes imposes a legal duty upon the Government and its administrative agencies to protect these tribal rights against infringement or loss. The role and legal authority of Indian tribes in the US are reviewed and the reasons why Indian tribes should be actively involved in project development and regional and national hydropower policy are discussed. Because of the inherent governmental status of Indian tribes, and their ownership and regulatory authority over important land, water and other resources, it is only logical that tribes be included in such activities. In practice, however, there is an absence of coordination between tribal governments and federal and non-federal project proponents.

30208 (TVA/PUB—84/21a, pp 434-443) **Municipal hydroelectric development: legal and socioeconomic study.** Pill, M.; Schneider, P.; Holzberg, C. 1983. NTIS, PC A24/MF A01. File Number DE84007682. (CONF-830939—Vol.1).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

Under the auspices of a federal grant from the Department of Health and Human Services, New England Energy Development Systems, Inc. (NEEDS) was retained by the Franklin Community Action Corporation (FCAC) in Greenfield, Franklin County, Massachusetts, to conduct a legal and socioeconomic study on municipal hydroelectric development at three existing dams. One dam is in the town of Conway, while the other two are in Greenfield. Since neither of the towns involved had municipal utilities, an important aspect of the study was to evaluate different options for hydro development. These options included: establishing a municipal utility, which would produce, transmit and distribute the electricity generated; developing a municipal system which would sell power to the local private utility; developing a hybrid approach involving both the town and a private entity; and leasing to private developers who would then have sole responsibility for construction and operation of the hydroelectric facility. Legal problems, economic advantages/disadvantages and methods of financing were taken into account in consideration of each option. Computerized pro forma cashflow analyses (developed by NEEDS) were included. Further assessment of the municipal utility option was provided by analyzing a number of interviews conducted with managers of existing Massachusetts municipal utilities, and supplementing these interviews with a review of municipal operating procedures and finances.

30209 (TVA/PUB—84/21b, pp 741-750) **Niagara project expansion.** Kerr, D.M. (New York Power Authority, Niagara Falls). 1983. NTIS, PC A99/MF A01. File Number DE84008049. (CONF-830939—Vol.2).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

A description of the plans of the New York Authority to expand their Niagara Power Project is provided. The Authority's approach and organization for licensing the project is discussed.

30210 (TVA/PUB—84/21c, pp 1174-1181) **Mediation: an effective way to settle hydro licensing disputes.** O'Connor, D.L. (New England Environmental Mediation Center, Boston, MA). 1983. NTIS, PC A20/MF A01. File Number DE84007687. (CONF-830939—Vol.3).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

The Federal Energy Regulatory Commission's licensing of numerous hydropower projects would be faster, simpler and less costly if the Commission could assign independent mediators to devise settlement agreements between hydro developers and intervenors who are concerned with the socio-economic and environmental impacts of the projects. Intervention proceedings caused lengthy delays in the Commission's licensing of hydropower projects. Procedural maneuvering inevitably results in increased project costs and does not always produce enhanced environmental protection. The Commission should take actions which will reduce delays and improve the quality of licensing decisions wherever legally and administratively possible. Two hydro disputes, settled with the help of an independent mediator, illustrate the potential value of mediation in the licensing process. These actions helped avoid costly and adversarial administrative proceedings at the state and federal level. The FERC has embodied settlement agreements in license conditions. The Commission does not have explicit authority in its current regulations to require parties to attempt to settle their differences in these cases. Proposed is that the Commission make certain additions and modifications to its regulations which would allow it to initiate settlement proceedings and assign a mediator to direct them.

1305 Economics And Management

REFER ALSO TO CITATION(S) 30106, 30112, 30147, 30183, 30192, 30367

30211 (CONF-7907129—, pp 67-72) **Some points on economic evaluation of small-scale hydro which should be kept in mind.** English, J.M. (Univ. of California, Los Angeles). May 1980. NTIS, PC A11/MF A01. File Number DE84005144.

From UCLA small-scale hydro resources development western regional workshop; Pomona, CA, USA (30 Jul 1979).

Economic evaluation of projects often appears very easy to many engineers. However, appearances are deceptive and a priori assumptions of easiness often are the result of serious misconceptions and lack of awareness of many of the subtleties which should be considered. This short review is made to call attention to some important points. These are: economic or investment evaluation versus financial evaluation, point of view, risk and the discount rate, inflation, and opportunity costs and shadow prices.

30212 (CONF-7907129—, pp 159-162) **Financing low-head hydroelectric projects.** McLeod, H.W. (New England Merchants National Bank, Boston, MA). May 1980. NTIS, PC A11/MF A01. File Number DE84005144.

From UCLA small-scale hydro resources development western regional workshop; Pomona, CA, USA (30 Jul 1979).

Methods for financing low-head, small-scale hydroelectric power plants are described. The key components of a successful low-head hydro project financing plan and the sources and types of financing available are discussed.

30213 (CONF-7907129—, pp 163-174) **Hydropower fundamentals.** Mayo, H.A. Jr. (Allis-Chalmers Corp., York, PA). May 1980. NTIS, PC A11/MF A01. File Number DE84005144.

From UCLA small-scale hydro resources development western regional workshop; Pomona, CA, USA (30 Jul 1979).

A fundamental background to hydro power in general is presented. More specifically, the US hydro-turbine industry, the market, institutional impacts, industry's current efforts to meet energy needs and potential benefits are discussed.

30214 (CONF-7907129—, pp 175-190) **Low head hydroelectric potential - economics and project development.** Willer, D.C. (Tudor Engineering Co., San Francisco, CA). May 1980. NTIS, PC A11/MF A01. File Number DE84005144.

From UCLA small-scale hydro resources development western regional workshop; Pomona, CA, USA (30 Jul 1979).

The economics of small-scale hydroelectric power plants is discussed. Case studies are presented that lead credibility to the feasibility of small hydroelectric power projects. These projects will not totally solve the motion's energy problems but they will permit the utilization of a natural resource that is now going to waste.

30215 (CONF-7907129—, pp 191-202) **Monopsony and the supply of power from small generating stations.** Brown, P.W. (Energy Law Institute, Concord, NH). May 1980. NTIS, PC A11/MF A01. File Number DE84005144.

From UCLA small-scale hydro resources development western regional workshop; Pomona, CA, USA (30 Jul 1979).

A private developer of a low-head hydroelectric site basically can only sell his output to two sources: a local municipality or the regional power grid. A municipal power company with power to sell has only one buyer. It is assumed that there is only one purchaser of power in the region, the regulated private utility. This utility is then in the position of a classic monopsony (single buyer), which purchases power from many existing power stations and is the market for any new power station. The advantages and disadvantages of purchasing electricity from outside the utilities generating system are discussed.

30216 (CONF-7907129—, pp 203-212) **Preliminary economic analysis of the value of contributions by small dams to system generation reliability.** Brown, P.W. (Energy Law Institute, Concord, NH). May 1980. NTIS, PC A11/MF A01. File Number DE84005144.

From UCLA small-scale hydro resources development western regional workshop; Pomona, CA, USA (30 Jul 1979).

Economists argue that electric rates, or for that matter any rate, for goods and services should reflect the marginal costs of production of those goods or services. In this line, they have described how prices should be set to maximize the sum of consumer and product surpluses (a standard measure of the total benefit to all participants in a given market) in cases where there are varying but cyclical demand patterns. This is the peak load pricing principle. The major result of the peak load pricing principle is that an explicit demand for capacity (fixed capital) was derived. This demand is determined from the cost structure of operating and capacity costs and the separate demands by the consumers in each subperiod (peak and off peak). This demand is for capital actually used during some part of the demand cycle. A framework to determine the value of capital for capacity when that capacity does not necessarily produce electricity, but is in place to assure system reliability is established. It is believed that it is reasonable to view small dams, even with highly varying outputs resulting from stream flow fluctuations, as positively contributive to system reliability. Accordingly, small dams should receive a payment for this good (reliability).

30217 (CONF-7907129—, pp 213-242) **Fundamental economic issues in the development of small scale hydro.** Brown, P.W. (Energy Law Institute, Concord, NH). May 1980. NTIS, PC A11/MF A01. File Number DE84005144.

From UCLA small-scale hydro resources development western regional workshop; Pomona, CA, USA (30 Jul 1979).

Some basic economic issues involved in the development of small-scale hydroelectric power plants (SSH) are discussed. The analysis is based on literature reviews, reviews of some cases studies of SSH projects, on site visits and continual discussion with the members of the Franklin Pierce - Thayer project and others working in the area. Broadly stated, economic analysis to date strongly suggests that the answers to the problem of the present slow rate of development of SSH projects are found in law books and regulatory codes and not in engineering manuals. Further analysis must be performed and additional data collected before the suggestion that legal and regulatory constraints are the major obstacle to SSH development becomes a conclusion.

30218 (TVA/PUB—84/21a, pp 457-467) **Power sales contracts from the developer's perspective.** Campbell, R.H. (Roberts and Shefelman, Seattle, WA). 1983. NTIS, PC A24/MF A01. File Number DE84007682. (CONF-830939—Vol.1).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

The various types and provisions of power sales contracts available to the project developer and the circumstances under which each should be used are discussed. Some innovative solutions to the problems inherent in small hydro development of assuring sufficient power sales revenue to pay high front-end capital costs, to make debt service payments and to pay maintenance and operation expenses during low water years, and to provide the developer an adequate return on his investment are also discussed.

30219 (TVA/PUB—84/21a, pp 468-475) **Power purchase contracts: impact on project risks and taxes.** Hough, T.C.; Goodwin, L.M. 1983. NTIS, PC A24/MF A01. File Number DE84007682. (CONF-830939—Vol.1).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

Long-term power purchase contracts are critical to the financial success of non-utility hydroelectric projects. Negotiated contracts can be designed to meet the requirements of the developer better than standard contracts currently available in some states. The value of power is determined by when power is produced, where it is produced and the characteristics of the purchasing utility. The tax planning aspect of power contracts can have a substantial impact on net revenues. The power purchase contract determines the amount and availability of tax benefits. These contracts may be characterized by the IRS as either service contracts, installment sales or leases.

30220 (TVA/PUB—84/21a, pp 476-483) **Financing hydro projects essential ingredients.** Bristol, D.R. 1983. NTIS, PC A24/MF A01. File Number DE84007682. (CONF-830939—Vol.1).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

Today many hydro projects have bridged the licensing and environmental hurdles and are ready to proceed to financing and construction. A view of financing and project development from a private developers standpoint is presented. For the purposes of this discussion, it is assumed that licensing has been completed, environmental problems have been resolved, and that the developer has control of the land required for the development. The purpose is to provide a framework for decision making on financing and construction. Within this framework a concept is presented allowing the developer to make only necessary expenditures commensurate with the risk. To put this process in perspective the need to examine the elements of developing a project and alternative approaches to manage the resources necessary to complete a project are discussed.

30221 (TVA/PUB—84/21a, pp 484-493) **Issues in private development at public hydropower sites.** Wilson, W.H.; Ringo, M.J. (ELI Corp., Concord, NH). 1983. NTIS, PC A24/MF A01. File Number DE84007682. (CONF-830939—Vol.1).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

Public entities have the potential to achieve a greater financial return from leasing their sites to private developers. After adjusting for practical problems with state and federal law, the financial market place and prospective private developers, expected financial returns under the two options are roughly equal. Further adjustment for the greater risk of public development shows an advantage in this approach for all but small projects. Care and skill in formulating such agreements is necessary to achieve the true financial potential for the public entity.

30222 (TVA/PUB—84/21a, pp 494-501) **Tailoring PURPA rates to meet the needs of small hydro developers.** Combs, B. (Public Utility Commissioner of Oregon, Salem). 1983. NTIS, PC A24/MF A01. File Number DE84007682. (CONF-830939—Vol.1).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

The Public Utility Regulatory Policies Act of 1978 requires electric utilities to purchase power from independent, privately owned cogeneration and small power production facilities. The price a utility must pay for power from such facilities is to be equal to the price the utility would have paid to produce the power itself or purchase it from another source. Given this general price guideline, avoided costs can be structured in a variety of ways. For the short term, sales for resale prices may be considered in the avoided cost analysis. For the long term, various levelizing techniques can be used to structure prices. Levelized prices can enable facility sponsors to meet their cash flow needs without causing ratepayers to pay more than they would have paid otherwise over the long term. The effect of several possible levelizing techniques on nominal prices is computed.

30223 (TVA/PUB—84/21a, pp 502-506) **Financing options for hydropower projects.** Hills, A. (Prudential-Bache Securities, Inc., New York, NY). 1983. NTIS, PC A24/MF A01. File Number DE84007682. (CONF-830939—Vol.1).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

The increasing cost of fossil-fueled electrical generation, combined with the uncertainties and delays in construction of new central station coal and nuclear power plants, has enhanced the economic feasibility of hydroelectric power projects. As an economic enterprise, the most important characteristic of small-scale hydropower projects is the capital intensive nature of their development. The capital costs for hydropower facilities can generally range from $750 to $2000 or more per kilowatt of installed capacity, depending upon the unique stream flow and geological characteristics of individual sites. In comparison, new coal-fired power plants cost from $900 to $1200 per kilowatt of capacity. This characteristic of hydropower facilities results in high front end costs, although the life cycle cost of the generated electricity can be very competitive with alternative energy sources. Annual project operating costs are likely to be a relatively small portion of total costs, while interest and principal payments on borrowed funds may be equal to 80% or more of annual expenses. The method by which a project will be financed, and at what interest cost, is of primary importance to the economic and financial feasibility of project development. The methods for financing small hydro projects are discussed.

30224 (TVA/PUB—84/21a, pp 507-516) **Project financing for low-head hydro - don't be late for the money.** Jaroch, T.D. (McDermott, Will and Emery, Boston, MA). 1983. NTIS, PC A24/MF A01. File Number DE84007682. (CONF-830939—Vol.1).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

Many developers of small hydroelectric facilities focus so much attention on the engineering and construction aspects of their projects that they minimize the kinds of considerations which will later affect their ability to close on their construction/rehabilitation financing. An acceptable power purchase contract is not enough. Most financial institutions will view project financing for low-head hydro from the perspective of a real estate loan. So also will the lawyers responsible for closing such financings, for the financial institution. It is important, therefore, that developers be alert to the documents and other elements which will typically be involved in a project financing. This discussion is not intended to deal with the wide range of possible closing requirements, but rather to focus upon several financing matters which typically have longer lead times and often are troublesome if not addressed early enough. A sample closing checklist is included and should provide a worthwhile overview of requirements for closing on a project financing.

30225 (TVA/PUB—84/21a, pp 517-526) **Recent developments in the taxation of hydropower projects.** Goodwin, L.M. (Goodwin and Schwartzstein, Washington, DC). 1983. NTIS, PC A24/MF A01. File Number DE84007682. (CONF-830939—Vol.1).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

The Economic Recovery Tax Act of 1981 (ERTA) and the Tax Equity and Fiscal Responsibility Act of 1982 (TEFRA) significantly changed the federal income taxation of businesses and individuals. Many of these changes have had a direct impact on the taxation of hydropower projects. Some changes, such as the acceleration of depreciation deductions, have made hydropower projects and other capital intensive projects more attractive as investments. Other changes, such as the basis adjustment and the at risk rules for the investment and energy tax credits, have had the opposite effect, and could actually make the financing of hydropower projects more difficult. This paper summarizes the tax consequences of investments in hydropower projects in light of these recent changes.

30226 (TVA/PUB—84/21a, pp 527-532) **Small hydroelectric projects as viable business enterprises.** Lystra, D.W. (Ayres, Lewis, Norris and May, Inc., Ann Arbor, MI). 1983. NTIS, PC A24/MF A01. File Number DE84007682. (CONF-830939—Vol.1).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

The recent history of small scale hydropower in the US has demonstrated the critical importance of project financing and project management issues. To be successful, small hydro projects must be viable business enterprises. Many sites which have been proved to be technically and environmentally feasible have not had the hoped-for development take place due to the absence of funding or a clear-cut project management program. The successful development of small scale hydropower demands that technical and institutional issues be properly blended with what may be called the entrepreneurial issues of finance and management. Too many site owners, whose attention has been focused on the technical details of equipment, facility design, utility interconnection, etc., have become discouraged when the financial support for the project did not spontaneously materialize. In frustration, many have abandoned their plans for hydroelectric development, or have turned the development rights over to other parties under sometimes unfavorable terms. Two successful small hydro projects are described as case studies to illustrate various ways in which project financing was secured and a managerial entity was created.

30227 (TVA/PUB—84/21a, pp 533-540) **Economic feasibility of small hydropower projects.** Freddolino, D.K.; Sundquist, M.J.; Keats, D.E.; Ross, K.L. (Proaction Institute, East Lansing, MI). 1983. NTIS, PC A24/MF A01. File Number DE84007682. (CONF-830939—Vol.1).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

The accurate determination of the economic feasibility of a small hydropower development project can have an important impact on the engineering plans and studies done for a site. Developers are, therefore, finding it increasingly important to examine the financial effects of a variety of development scenarios and to perform appropriate economic analysis to determine if and under what circumstances the development of a site can be profitable. The benefits, flexibility and liability which result from various public and/or private development options are reviewed. The effects of newly enacted tax legislation benefits to be accured from the operation of a small hydroelectric facility and subsequent impact on the financial feasibility of a project are also examined. A case study, demonstrating the use of a financial analysis to examine various options for a joint public/private hydroelectric venture is presented.

30228 (TVA/PUB—84/21a, pp 541-547) **Capacity values and adjustments.** Biggerstaff, G. 1983. NTIS, PC A24/MF A01. File Number DE84007682. (CONF-830939—Vol.1).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

The Water Resources Council's Procedures of December 14, 1979, explicitly recognized the concept that hydroelectric capacity which may not meet the traditional definition of dependable capacity has some value. One purpose of the Water Resources Council's Water and Energy Task Force established to develop methods for implementing the proposed Procedure was the development of an appropriate basis for applying capacity adjustments to reflect the greater reliability of hydropower and also the value of intermittent capacity. A procedures was subsequently developed by Federal Energy Regulatory Commission (FERC) staff based on the load-carrying capability (LCC) concept utilized by many electric utilities in planning generating unit additions. Studies indicated that the appropriate capacity value adjustment to apply to hydropower additions to reflect credits for reliability and intermittent capacity can be determined by developing the ratio of the overall availability (reflecting both its hydrologic availability and its mechanical availability) of the hydropower addition during the peak load season to the mechanical availability of the thermal alternatives during the same period. The annual capacity value of a hydropower addition would thus be the dollars per kilowatt-year cost of the thermal alternative times the overall availability of the hydro addition, divided by the availability of the thermal addition. Depending on the operating characteristics of both the hydro addition and the thermal alternative, up to another 5% could be added to this annual capacity value to reflect any operating flexibility advantages of the hydro project. The development of the method is discussed, and some of the advantages and shortcomings of the procedures are identified.

30229 (TVA/PUB—84/21a, pp 548-552) **Small hydroelectric financial-economic analysis on a micro-computer.** Klotz, L.H. (Univ. of New Hampshire, Durham). 1983. NTIS, PC A24/MF A01. File Number DE84007682. (CONF-830939—Vol.1).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

There are a set of continuing problems with performing a financial-economic analysis of a small hydroelectric facility. The varying data needs for the type of participant in the financing and development process are discussed. That is, the economic data requests and utilization by a developer, investor and debt lending-institution will be generically different from one another even though there will be instances of similarities. A second area of concern for this diverse group is to mutually determine or agree upon debt/equity values that will meet their mutually exclusive financial objectives. Based on past experiences with other developments of facilities, including other small hydro facilities, debt/equity ratios may be selected which are inappropriate for the specific small hydro facility under consideration for development. The results of this approach is often the evaluation that the proposed facility is economically marginal or infeasible. A third problem is the lack of a fast, inclusive, inexpensive and readily available process for the financial-economic analysis. As an approach to resolve these problems, the SHFEAM (Small Hydro-Electric Financial-Economic Analysis on Micro-computers) program has been developed. This program generally follows the logic of the SHYFEA (Small Hydro-Electric Financial/Economic Analysis) program which operates on a main-frame computer, but it has been updated and expanded. The approach is described.

30230 (TVA/PUB—84/21a, pp 393-404) **Regional assessment of small scale hydropower - a methodology for developing countries.** Little, G.E. (Tudor Engineering Co., San Francisco, CA). 1983. NTIS, PC A24/MF A01. File Number DE84007682. (CONF-830939—Vol.1).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

A methodology is presented for the regional assessment of small scale hydroelectric potential which makes use of the principle of representative sampling and analyses of typical projects followed by the extrapolation of the results to the regional area for the overall assessment. Statistical theory is utilized to estimate the margin of error involved in the extrapolation procedures. Use of the methodology should result in reasonably accurate estimates in a short period of time of the number, size, and cost of the economically justified small-scale hydroelectric projects which could be developed in the particular region or country under study. It is assumed that the primary use of the methodology will be to obtain an initial estimate of the number and cost of small-scale hydroelectric sites in a region so that the likely scope and economic benefits of a long-term development program can be assessed.

30231 (TVA/PUB—84/21a, pp 444-450) **Power purchase contracts - some suggested approaches.** Brown, P.W. (ELI Corp., Concord, NH). 1983. NTIS, PC A24/MF A01. File Number DE84007682. (CONF-830939—Vol.1).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

The power purchase contract is a critical component of many hydroelectric projects being developed by non-utility developers. To reduce the risks of protracted negotiations or worse, negotiation stalemates, it is necessary for the developer to understand fully the financing requirements of the project under consideration. Second, it is necessary for the developer to be fully informed about state regulatory action in enforcing the regulations promulgated under the Public Utility Regulatory Policies Act of 1978 (PURPA) and state regulatory mechanisms available to assist in the negotiating process. Third, it is necessary for the developer to understand the utility with which negotiations are to be undertaken. The form of payment for the production by the hydroelectric facility may vary depending on the flexibility and imagination of the negotiators of the contract. The level of the payments, however they are scheduled, will be constrained by the short run and long run marginal costs confronting the purchasing utility.

30232 (TVA/PUB—84/21a, pp 451-456) **Utility interface.** Kekuna, H.S.L. (Pennsylvania Power and Light Co., Pittsburgh). 1983. NTIS, PC A24/MF A01. File Number DE84007682. (CONF-830939—Vol.1).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

An insight is presented, from one utility's experience, into what the developer needs from a utility to make a project happen, why the utility might be concerned with these needs, and how the utility and developer can work together to mitigate each others' concerns to their mutual advantage. The discussion focuses on interconnection requirements, buy-back rates, and power purchase contract options.

30233 (TVA/PUB—84/21a, pp 239-248) **Costs of small hydro projects.** Christensen, J.P. (International Engineering Co., Inc., San Francisco, CA). 1983. NTIS, PC A24/MF A01. File Number DE84007682. (CONF-830939—Vol.1).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

A cost analysis of eight recently constructed small hydroelectric projects is presented. They are all low-head developments in the capacity range of 1325 kW to 24,000 kW constructed at existing dams or canals in the US. Development was carried out by private developers, utilities, irrigation districts, industries, and municipalities with partial funding provided under the Department of Energy's Small Hydropower Technology Development Program. The total costs of generation capacity ranged from $663/kW to $2571/kW in January 1983 dollars and the weighted average was $2046/kW. Direct construction costs accounted for between 56 and 96% of the total project cost. The remaining 43 to 4% of total costs were indirect costs which included engineering, administration, legal and financing expenses. Total actual project costs varied from -5 to +55% of estimated costs. Civil works costs were primarily responsible for this variance.

30234 (TVA/PUB—84/21a, pp 266-273) **Micro-hydro development at the crossroads.** Parrow, D.M. (Oregon Dept. of Energy). 1983. NTIS, PC A24/MF A01. File Number DE84007682. (CONF-830939—Vol.1).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

Micro-hydro represents an opportunity for the average landowner to produce electric power. Installation of generating equipment and the sale of power to a local utility can provide a developer with a significant second income. Or, it can represent a string of broken promises and wasted resources. Micro-hydro development is at the crossroads. It has gained popularity with the public. Stories about micro projects frequently are featured in the news media, but lately many of those stories focus on projects which have failed. Most of the development problems with which we are familiar, are the result of grossly inadequate feasibility study, inadequate project design, shoddy installation, and faulty equipment. Continued negative publicity will seriously slow development of this renewable resource. To ensure that development of micro-hydro continues, the industry must work aggressively to reduce the number of projects which fail. Potential developers must fully understand the process for developing a process and the issues which they will have to confront during the development process. We must all work together to ensure that every project constructed is technically and economically sound.

30235 (TVA/PUB—84/21b, pp 558-566) **Pre-feasibility cost estimates for hydropower at existing dams.** Gulliver, J.S.; Dotan, A. (Univ. of Minnesota, Minneapolis). 1983. NTIS, PC A99/MF A01. File Number DE84008049. (CONF-830939—Vol.2).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

Guidelines for quick and simple hydropower project cost estimates are developed for pre-feasibility site assessments. The guidelines are based upon a concept which incorporates a single equation utilizing design power and head for total equipment cost and a site factor to determine total project cost. Total project cost is estimated by multiplying the equipment cost, obtained from the equation, and the site factor. Total project cost data from a number of hydropower projects are compiled to provide guidelines for choosing the site factor, which is shown to vary greatly, especially for micro (<100 kW) and mini (>1000 kW) hydropower projects. Envelope curves for site factor are given, and a weighting factor, which is the fraction distance between upper and lower envelope curves, is chosen for each site. The choice of weighting factor for a given site is based upon comparison with recently completed projects, a knowledge of the components which can greatly increase civil works costs, and engineering judgment. The weighting factor is then used in calculations to determine optimum plant capacity. The methodology was used in a survey of the hydropower potential at existing Minnesota Dams, which is presented as a case study.

30236 (TVA/PUB—84/21b, pp 567-575) **Case study of hydropower formulation, Kaw Lake, Oklahoma.** Hight, R.R.; Munsell, F.J. (Army Engineer District, Tulsa, OK). 1983. NTIS, PC A99/MF A01. File Number DE84008049. (CONF-830939—Vol.2).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

The Production Cost Avoidance (PCA) methodology developed by the Tulsa District, Corps of Engineers, as it was applied in a 1982 hydropower study for Kaw Lake, Oklahoma is described. The impact of the PCA method on hydropower formulation is shown by comparison of the 1982 study to an earlier study for the same site.

30237 (TVA/PUB—84/21b, pp 576-584) **Optimizing hydroelectric systems and equipment.** Neumann, C.A. 1983. NTIS, PC A99/MF A01. File Number DE84008049. (CONF-830939—Vol.2).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

Optimization of a hydroelectric system requires detail engineering and cost coordination of the hydraulic, electrical, mechanical and civil aspects. Project objectives need to be established and selection of financing criteria are fundamental requirements. Optimization work would only start after a thorough site investigation to ensure that the project is feasible and the basic design approach and agreed upon objectives are fundamentally sound. This is to say that alternative design approaches such as for a new installation, rehabilitation or uprating of a plant should be evaluated. For installations with low heads of 15-30 ft. and capacities up to 100MW, sites can utilize conventional powerhouse construction or prefabricated power structures, horizontal, vertical or inclined arrangements, single or double regulated turbines, synchronous or induction generators - direct coupled or higher speed generators using speed increasers. With this many potential design choices, it becomes increasingly important to establish the most cost effective design approach. Optimization work based on ineffective use of the hydro resource or high capital cost is not productive. Experience has shown that an inherently higher cost system design will not result in an optimized project.

30238 (TVA/PUB—84/21b, pp 595-604) **Planning power resources in the Pacific Northwest.** Lambie, M.B.M. (Bonneville Power Administration, Portland, OR). 1983. NTIS, PC A99/MF A01. File Number DE84008049. (CONF-830939—Vol.2).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

The power planning activities in the four state region serviced by the Bonneville Power Administration, the US Power Marketing Agency in the Pacific Northwest are described. The importance of the hydroelectric resource in the region is shown and the balance sought between fish and wildlife habitat and the use of the water resource for power production is discussed.

30239 (TVA/PUB—84/21b, pp 615-624) **Hydroelectric resource potential at new damsites in the seventeen western states.** Willerl, D.C.; Williams, J. (Tudor Engineering Co., Denver, CO). 1983. NTIS, PC A99/MF A01. File Number DE84008049. (CONF-830939—Vol.2).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

Tudor Engineering Company recently completed a study of the hydroelectric potential of undeveloped low-head (less than 66 feet) sites in the seventeen western states. In the first part of the study, which utilized a listing of the hydro sites included in the Corps of Engineers (Corps) National hydro-power study, 2600 potential low-head sites were identified. These potential sites included 500 new undeveloped sites identified by Tudor that were not on the Corps list. After the 2600 sites were screened, 86 sites were selected for appraisal level studies, which was the second part of the study. The methodology, power studies, layout studies, cost estimates and economic analysis that were conducted for the appraisal level studies for the 86 sites are summarized. The results of the appraisal studies were encouraging. Out of the 86 sites, 57 were found to be economically feasible. For the 57 sites, the total installed capacity is 598,000 kilowatts and the installed capacity sizes selected range from about 1200 kilowatts to 30,000 kilowatts. The average annual energy potential of the 57 feasible sites is estimated to be about 3300 gigawatt-hours. The estimated capital cost is about $1.3 billion for the 57 feasible sites, which is about $2165 per kilowatt.

30240 (TVA/PUB—84/21b, pp 710-719) **Case study - New Martinsville Hydroelectric Project.** Linzell, L.E.; Pritchard, D.F. 1983. NTIS, PC A99/MF A01. File Number DE84008049. (CONF-830939—Vol.2).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

With a rated head of 19 1/2 feet and with a discharge of 24,000 cubic feet per second for both turbines at rated discharge, the New Martinsville Hydroelectric Project is one of the lowest head - high flow hydroelectric projects being developed in the US. The project is located at the Corps of Engineers' Hannibal Locks and Dam in New Martinsville, West Virginia. The powerhouse will contain two horizontal axis, 17 megawatt (MW) bulb turbines with runners about 7 meters in diameter. The location, on a major navigable stream, allows the option of prefabrication of the powerhouse structure at any adequately sized shipyard or barge manufacturing facility, with resultant cost savings. The expected average annual energy production is 208 gigawatt-hours.

30241 (TVA/PUB—84/21b, pp 719a-719r) **Development of the North Mississippi Flood Control Water Power Project.** Newton, J.S.; Mathews, C.M.; Earles, J.D. (Civil Engineering, Montgomery, AL). 1983. NTIS, PC A99/MF A01. File Number DE84008049. (CONF-830939—Vol.2).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

On April 15, 1983, the Federal Energy Regulatory Commission (FERC) issued major license 3036-001 to the Municipal Energy Agency of Mississippi (MEAM) for the construction of what will be the first hydroelectric generating facilities in the State of Mississippi. MEAM, which is comprised of eight Mississippi municipalities, is pursuing the development of hydroelectric power at four existing US Army Corps of Engineers (Corps) flood control dams located in North Central Mississippi. These hydroelectric sites are collectively referred to as the North Mississippi Flood Control Water Power Project. All four generating facilities will be run-of-flood control release type. Therefore, flood control requirements, determined by the Corps, will dictate available flow and head. To accommodate these hydroelectric generating facilities on Corps dams, close coordination and cooperation between MEAM and the Corps has been and will continue to be important for timely project execution. Major design and environmental issues which affect Corps structures and lands are being resolved with the Corps. These issues include impacts on recreational opportunities and channel dissolved oxygen at each site. Additionally, Corps review and approval is required for the diversion during construction plan, tunnel lining operations and excavation and dewatering. MEAM's project-to-date coordination effort with the Corps on issues related to the continued development of this project is discussed.

30242 (TVA/PUB—84/21b, pp 720-730) **Hydroelectric development on the Ohio River.** Lawrence, J.D.; Burgoine, D. 1983. NTIS, PC A99/MF A01. File Number DE84008049. (CONF-830939—Vol.2).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

The Corps of Engineers operates a total of 20 lock and dam structures on the 980 mile long Ohio River. The hydroelectric power potential at these dams has long been recognized and in several cases has already been developed. The high initial investment costs and limitation on dependable capacity at these sites dictate that construction costs be minimized if any economic benefits are to be realized. This has led to several innovative design techniques for these installations to try to cut costs. The prefabricated float-in powerhouse concept is one such approach. Studies undertaken by Acres American Incorporated have shown that although these concepts are potentially sound, it has yet to be conclusively demonstrated that any significant economic benefits can be realized in practice.

1306 Environmental Aspects

REFER ALSO TO CITATION(S) 30105, 30106, 30152, 30204, 30209, 30210, 30238, 30241

30243 (CONF-8505147—2) **Approach for assessing fisheries impacts of basin-wide hydropower development.** Cada, G.F.; McLean, R.B. (Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 22p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85012886.

From Symposium on small hydropower and fisheries; Denver, CO, USA (5 May 1985).

An application of a matrix technique to the assessment of hydropower impacts on resident trout in the Upper San Joaquin River Basin in California is presented. Advantages and limitations of the approach as a tool for evaluating multiple-project impacts are described. Recommendations are made for further development of the matrix technique to perform basin-level, cumulative impact assessments.

30244 (CONF-8505148—1) **National perspective on environmental constraints to hydroelectric development.** Hildebrand, S.G.; Sale, M.J.; Cada, G.F.; Loar, J.M. (Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 12p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85013111.

From National conference on perspectives on nonpoint source pollution; Kansas City, MO, USA (19 May 1985).

Two issues are analyzed relative to problems associated with the concentration of dissolved oxygen in tailwaters below dams and instream flow requirements for fisheries. The need for and technical challenges related to assessment of the environmental effects of multiple-project development in river basins are discussed. Although the focus of the DOE program is on small-scale hydroelectric development, the issues discussed here are applicable to large-scale facilities as well.

30245 (N—85-16374) **Ecological impacts of hydroelectric projects in Amazonia.** Dossantos, J.M. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)). 1984. 15p. NTIS MF A01.

In WMO, climate conference for Latin America and the Caribbean, 379-393 p. (N—85-16352 07-47).

Studies on ecosystem modifications in a micro and meso climatic scale for the Tucurui (Brazil) hydroelectric project are presented. The study examined a rational development based on the region's economic potential, without violating the ecological restrictions. Limnology, Macrophytes, Ichtyofanna, phytomas, meteorology and climatology are discussed. The perturbations are not necessarily prejudicial to the ecosystem that is characterized by dynamic processes resulting from natural perturbations. (ESA)

30246 (NP—5750811) **Indian areas threatened by hydroelectric projects in Brazil.** Aspelin, P.L.; Santos, S.C. dos. (International Work Group for Indigenous Affairs (IWGIA), Copenhagen (Denmark)). Oct 1981. 229p. NTIS (US Sales Only), PC A11/MF A01. File Number DE85750811.

In Brazil, as elsewhere, high priority is being given to developing domestic energy sources due to the spectacular increase in the cost of imported petroleum in recent years. This paper discusses the present situation of the thirty-two to thirty-four various Indian areas presently known to be threatened by seven major hydro-electric projects and one flood-control project, either planned or underway, in or directly involving Brazil. A total of at least 100,000 hectares of Indian land (or nearly one hectare for each remaining Brazilian Indian) will be flooded or otherwise expropriated by these projects. Past efforts by the Brazilian National Indian Foundation (FUNAI) to protect the Indians from the pressure of "national development" have not been sufficient. Research, planning, publicity, and political pressure are necessary to ensure that their efforts regarding these hydroelectric projects are more successful.

30247 (TVA/PUB—84/21c, pp 1154-1163) **Environmental impact of hydropower development.** Parker, F.L.; Thackston, E.L. (Vanderbilt Univ., Nashville, TN). 1983. NTIS, PC A20/MF A01. File Number DE84007687. (CONF-830939—Vol.3).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

The environmental impacts of hydropower developments have been widely observed. The initial reduction in salmon runs in the Columbia River has been attributed to closure of the river by construction of dams for hydroelectric power. The more recent reduction in fish runs may be due to this closure, plus hatchery practices, oceanic conditions such as coastal upwelling, fishing pressure, and biological cycles. The effect of reduction of flood flows and the sediments and nutrients that they carry has perhaps been most vividly illustrated in the damming of the Nile, with the resultant need for artificial fertilizers and a large reduction in Eastern Mediterranean fisheries. The increased slack water could promote the spread of bilharziasis. The storage of water in surface reservoirs in hot arid regions such as Colorado increases evaporation losses. When the water is used for peaking purposes, profound changes in the biota occur. The stratification of reservoirs can change pre-impoundment cold water stream fisheries to primarily warm water reservoir fisheries. Changes of this nature are seen on the Tennessee River. Proposed developments in the Eastern Soviet Union would reverse flows in a number of streams from the Arctic Ocean to the south. This could potentially affect the climate of the entire Northern Hemisphere. Increased pressure on the earth's crust by reservoir waters could induce seismic events.

30248 (TVA/PUB—84/21c, pp 1164-1173) **Environmental economics of hydropower development.** Stavins, R.; Willey, Z. (Environmental Defense Fund, Berkeley, CA). 1983. NTIS, PC A20/MF A01. File Number DE84007687. (CONF-830939—Vol.3).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

In order to assess adequately the public merits of proposed hydroelectric projects, it is essential to internalize, whenever possible, significant environmental externalities. Such a social benefit-cost (B/C) analysis is conducted of a proposed new hydropower project on the Tuolumne River in California. The project, which had been judged financially feasible in prior (internal) benefit-cost analyses, is found to exhibit a B/C ratio significantly less than 1.0 when environmental impacts are even partially internalized.

30249 (TVA/PUB—84/21c, pp 1182-1190) **Addressing environmental concerns in water resource projects.** Crossman, J.S.; Duda, A.M. (Tennessee Valley Authority, Knoxville). 1983. NTIS, PC A20/MF A01. File Number DE84007687. (CONF-830939—Vol.3).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

A recognizance-level survey of environmental concerns associated with hydropower and water resource development was undertaken. Particular attention was given to environmental issues in the Columbia and Tennessee River systems. Landmark legislation, agency responses, and the fundamental underlying causes for not addressing environmental concerns are discussed. Other water resource developments are also examined with attention given to environmental problems and the transfer of their associated costs from the private to public sector. Specific recommendations are proposed for incorporating environmental concerns in project plans and justifications. Several policy options are also presented for meeting this country's water resources challenge.

30250 (TVA/PUB—84/21c, pp 1191-1200) **Modifications to the fishery at Rocky Ford Dam, Kansas.** Hinson, M.O. Jr.; Gebhard, T.G. Jr.; Hartmann, R.F. (Engineering-Science, Austin, TX). 1983. NTIS, PC A20/MF A01. File Number DE84007687. (CONF-830939—Vol.3).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

During 1982, a study was conducted to evaluate the rehabilitation of hydroelectric facilities at Rocky Ford Dam. Rocky Ford Dam is owned by the Kansas Fish and Game Commission and is located in one of the state's most popular recreational fishing areas. The principal objective of the environmental assessment task of the feasibility study was to address the following three environmental issues: (1) maintenance and enhancement of public access and use, (2) effects of hydroelectric operations on fishery resources, and (3) evaluation of potential for adverse impact due to the existence of super-saturated gasses in the releases from an upstream reservoir. The required site modifications under the selected plan were designed to provide new habitat areas and fisherman access areas that would complement hydroelectric generation. Removal of rubble and gravel substrates for the turbine discharge channel will create opportunities to use this fill material to construct groins, dikes, and other fill areas that would create new fishable locations. This case study illustrates how proposed modifications to a small-scale hydroelectric project and the downstream habitat can maintain, and even enhance, a productive fishery habitat and public access to that fishery.

30251 (TVA/PUB—84/21c, pp 1201-1212) **Effects of hydropower development on Columbia River salmonids.** Rondorf, D.W.; Gray, G.A.; Nelson, W.R. (Fish and Wildlife Service, Cook, WA). 1983. NTIS, PC A20/MF A01. File Number DE84007687. (CONF-830939—Vol.3).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

Main stem hydroelectric dams in the Columbia basin have deleterious effects on Pacific salmonids that are difficult to reverse with available technology. Hydropower dams have not only flooded spawning areas but have markedly increased the mortality of adult and juvenile salmonids during their migrations. Improved fish ladder design has reduced mortality and delay of adult salmonids during migration, but many problems still persist. Mortality of juvenile migrants has been reduced by traveling screens in turbine intakes, collection of fish and transportation around dams to downstream release sites, and installation of spillway deflectors to reduced gas supersaturation. Part of the mortality of juvenile salmonids during emigration has been attributed to increases in outmigration time and the associated increase in predation and bioenergetic demands, but these sources or mortality have not been quantified. Mitigation practices and recently increased demand for hydropower have resulted in new problems. Increased production of fish in hatcheries to compensate for losses resulting from past hydropower development has created a mixed-stock fishery in which it is difficult to protect naturally produced stocks and yet fully harvest abundant hatchery stocks. Increased demand for low-cost hydropower has led to the installation of additional generating units and changes in regional water management. Regional power planning holds promise as an approach toward mitigating the effects of hydropower development and improving salmonid populations.

30252 (TVA/PUB—84/21c, pp 1213-1218) **Conflict in reservoir management: water quality vs fisheries.** Sasseville, D. (Normandeau Associates, Inc., Bedford, NH). 1983. NTIS, PC A20/MF A01. File Number DE84007687. (CONF-830939—Vol.3).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

The apparent sister disciplines, water quality and fisheries biology, may promote conflicting viewpoints when addressing impacts and mitigative measures associated with hydroelectric facility development. The water quality scientist assumes that the cleaner-the-better is the utmost goal of a reservoir management program while the fisheries scientist is often eager to trade some water quality increments to maximize the sport fisheries. Each group has justification for its perspective but identification of critical issues early in the project's life stage coupled with quantification of the impacts and mitigative benefits provides the best resolution.

30253 (TVA/PUB—84/21c, pp 1219-1229) **Preventing fish mortality at hydropower facilities.** Taft, E.P. III; Bazarian, E.; Cook, T.C. (Stone and Webster Engineering Corp., Boston, MA). 1983. NTIS, PC A20/MF A01. File Number DE84007687. (CONF-830939—Vol.3).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

The recent increase in small-scale hydropower development in the United States has raised several environmental concerns regarding facility design and operation. Migratory and resident fish mortality resulting from turbine passage is a major issue. To mitigate this mortality, considerable attention has been given to applying available fish protection systems to hydropower facilities. To date, much of the development effort regarding fish protection has concentrated on preventing fish losses at steam electric power stations. Designs and operational information for application of fish protection systems to hydropower facilities is generally lacking for many of the available technologies. Current fish protection technologies fall into one of three broad categories: behavior barriers, fish collection systems, and fish diversion/deterrent devices. Behavior barriers have not generally been proven effective and/or reliable in the protection of fish. Fish collection systems appear to have some application to hydropower facilities but may not be highly effective. Several hydropower facilities have used fish diversion systems with varying success for diverting downstream migrants. Of the available technologies, diversion screens, although relatively costly, may offer the greatest potential for effective fish protection.

30254 (TVA/PUB—84/21c, pp 1230-1238) **Environmental impact of reservoir on the Merse River, Italy.** Olivetti, G. (Dagh Watson, S.p.A., Milan, Italy). 1983. NTIS, PC A20/MF A01. File Number DE84007687. (CONF-830939—Vol.3).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

By the construction of an impounding reservoir on the River Merse, the Farma-Merse Project aims to provide improved irrigation facilities for the Rosia Region and part of the Grossetana Plain. This scheme, together with the Riforma Fondaria (a government-sponsored land development scheme), is expected to enable approximately 37,000 ha of land to be made available for agricultural use. In addition to providing water for irrigation, the reservoir will also provide a means of satisfying the increasing demand for water for domestic and industrial purposes in this region. It will also serve as a means of flood alleviation, particularly for the Grossetana region, which is prone to flooding during periods of heavy rain. Floods such as those which occurred in 1966 should not occur after the reservoir has been constructed. At present, the reservoir is not intended to be used for hydroelectric power generation. The proposal for an impounding reservoir made by the Agricultural and Forest Development Agency for Toscana (ETSAF) recommends the construction of a dam on the River Merse in the Ferrale Plain region of Toscana, southwest of Siena. The impounding reservoir so formed would contain approximately 110 million m^3 of water derived not only from the River Merse but also from the Rivers Farma and La Gonna. The study undertaken principally concentrates on the probable environmental effects that will result upon construction of this reservoir.

30255 (TVA/PUB—84/21c, pp 1239-1243) **Water power developments in Norway, environmental considerations.** Mellquist, P. 1983. NTIS, PC A20/MF A01. File Number DE84007687. (CONF-830939—Vol.3).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

Norwegian water resources are sought after for several purposes, hydroelectric power production being one of them. In 1982, 99.8% of Norway's electrical energy was generated by hydro power. The government has decided that at least until the year 2000 Norway's needs for electricity shall continue to be met by hydro power exploitation. Both nationally and internationally the question of energy production in its broadest sense includes weighing economic advantages against effects on nature and environment. These aspects are not easy to compare and are therefore debated in a number of fora, both political and public-interest oriented. This is not unique for Norway, but is a pattern that most people will recognize. The problems involved in the development of Norway's water resources are discussed.

30256 (TVA/PUB—84/21c, pp 1244-1253) **Environmental programs for large dams in Indonesia - some practical considerations and lessons learned.** Graybill, D.L. (Gilbert/Commonwealth, Reading PA). 1983. NTIS, PC A20/MF A01. File Number DE84007687. (CONF-830939—Vol.3).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

This paper (a) outlines how land compensation, resettlement, and the building of an in-house environmental management unit were planned and are being implemented for two large hydroelectric projects in Indonesia; (b) compares the environmental programs of these and three other dams in Indonesia; and (c) suggests some practical considerations and lessons learned that may be applicable to environmental management for other projects.

30257 (TVA/PUB—84/21c, pp 1254-1273) **Prediction of water quality in proposed hydropower impoundments.** Lee, G.F.; Jones, R.A. (Texas Tech Univ., Lubbock). 1983. NTIS, PC A20/MF A01. File Number DE84007687. (CONF-830939—Vol.3).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

The development of a hydropower impoundment normally has a significant impact on the water quality characteristics of the water in the area dammed, as well as the watercourse downstream of it. In addition to removing turbidity, impoundments may convert innocuous forms of iron manganese, and sulfur to chemical forms that can have a significant adverse impact on the water quality of the down stream water receiving the hydropower discharges. The primary factor governing transformations of this type is the trophic state of the waterbody, which is controlled by the aquatic plant nutrient (primarily phosphorus) load to the waterbody and the morphology and hydrology of the waterbody. The US OECD eutrophication study yielded information that can be used to predict the trophic state of a proposed hydropower impoundment. Nutrient export coefficients were developed allowing estimations to be made of the amount of phosphorus that will be received by a waterbody from its watershed. This phosphorus load, combined with the area, mean depth, and hydraulic residence time planned for the waterbody, can be used to predict the planktonic algal chlorophyll concentrations. This information can then be used to predict both in-lake and downstream oxygen, sulfide, iron, and manganese-related water quality problems.

30258 (TVA/PUB—84/21c, pp 1284-1293) **Accuracy and precision in estimating instream flow requirements.** Downing, J.K. (Stone and Webster Engineering Corp., Boston, MA). 1983. NTIS, PC A20/MF A01. File Number DE84007687. (CONF-830939—Vol.3).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

The minimum releases of reservoir waters required for the protection or enhancement of environmental resources are known as minimum insteam flows. Typically, the releases are intended to protect sensitive fish and wildlife from no flow or extreme low flow conditions. These minimum instream flows have been required by regulatory agencies at some large generating facilities for many years. More recently, minimum flows have been required as a condition of licensing or relicensing of nearly all hydroelectric facilities. In the past, the determination of magnitude, duration and seasonality of the required minimum flows was based on hydrologic characteristics such as 7Q10 or watershed of the river or reservoir. Increasingly, biological models or the combined application of hydraulic and biological models are used to determine the magnitude of these minimum releases. The methods used to determine minimum flow releases can have direct influence on the economic feasibility of a project by affecting the design of new facilities, and the operational modes of new and existing facilities. Therefore, the precision and accuracy of these methods can be as pertinent to the feasibility of a project as the determination of effective head or flow duration. The precision and accuracy of the output of various methods used for minimum instream flow determinations to measurements of parameters typically determined by hydroelectric engineers in designing facilities or defining operation modes are compared.

30259 (TVA/PUB—84/21c, pp 1294-1304) **Instream flow: increased accuracy using habitat mapping.** Morhardt, J.E.; Hanson, D.F.; Coulston, P.J. (Ecological Analysts, Inc., Lafayette, CA). 1983. NTIS, PC A20/MF A01. File Number DE84007687. (CONF-830939—Vol.3).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

The US Fish and Wildlife Service Incremental Flow Instream Methodology commonly utilizes either of two quite different hydraulic models (in conjunction with a habitat suitability model) to evaluate the effects of proposed stream discharged regimes on fish habitats. The newer of these, the IFG4 model, has the potential to overcome many of the limitations of the earlier IFG2 (WSP) model. The use of habitat mapping and selectively dispersed transect placement to improve the accuracy of habitat predictions using the IFG4 model is described.

30260 (TVA/PUB—84/21c, pp 1314-1325) **Water quality management of hydropower discharge.** Speece, R.E. (Drexel Univ., Philadelphia, PA). 1983. NTIS, PC A20/MF A01. File Number DE84007687. (CONF-830939—Vol.3).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

D.O. depletion is commonly noted in the discharge of hydroelectric dams. It is less severe on run-of-the-river dams and more severe on tributary dams having long detention times. Hydroelectric power discharges from tributary dams commonly fail to comply with downstream water quality standards for 100-150 days per year. Turbine venting of the discharges is one of the most favored alternatives being considered to increase the D.O in the discharges. The resulting ratio of dissolved oxygen/nitrogen is significantly different in turbine venting than in spillway discharges. The present US EPA water quality standard of 110% total gas pressure, which evolved primarily from spillway discharge experiences on the Columbia River, is questioned with reference to its appropriateness to turbine discharges. Turbine discharges characteristically contain much lower dissolved oxygen/nitrogen ratios than spillway discharges. Fish response to decreasing dissolved oxygen/nitrogen ratios when total gas pressure is held constant manifests increased severity of symptoms and increased rate of mortality to gas bubble disease. There is a paucity of dissolved nitrogen data in turbine vented discharges and no correlation with the fraction of rated discharge capacity at which the turbine is operating as well as the rate at which air is being drawn in through the vacuum breakers. It is cautioned that these field data should be collected and evaluated before any large-scale program of turbine venting is employed to supplement the D.O. in oxygen depleted hydropower discharges.

30261 (TVA/PUB—84/21c, pp 1326-1335) **Experience with reservoir release aeration and flow improvement.** Davis, J.L.; Bohac, C.E. (Tennessee Valley Authority, Knoxville). 1983. NTIS, PC A20/MF A01. File Number DE84007687. (CONF-830939—Vol.3).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

The Tennessee Valley Authority's (TVA's) three-year experimental reservoir release improvement program has been directed toward improvement of dissolved oxygen and flow. The program is reviewed giving special emphasis to not only the successful experiments, but also where unanticipated results occurred. In cases where difficulties arose, solutions, to them are discussed. The experiences documented are directed in the hope that they may help others interested in employing reservoir release improvement methods.

30262 (TVA/PUB—84/21c, pp 1336-1345) **Current status of turbine aeration activities at Alabama Power Company.** Miller, D.E.; Sheppard, A.R. (Alabama Power Co., Birmingham). 1983. NTIS, PC A20/MF A01. File Number DE84007687. (CONF-830939—Vol.3).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

During the past decade engineers at Alabama Power Company have directed the research, development, design, installation and testing of the concept of installing deflector plates and air ports in the upper draft tube wall of hydroelectric turbines to aspirate a predetermined quantity of air into the turbine discharge, the objective being to enhance the dissolved oxygen content. A summary of the design of the deflector plate aeration system at the Company's newly constructed R.L. Harris Project which became operational in April, 1983 is presented. A brief description of the bolt-on deflector plate concept being utilized at Mitchell Dam is also discussed. It is believed that the engineering capability now exists to evaluate, design and install efficient deflector plate aeration systems, as an integral part of new construction or as a retrofit in existing units, to meet design goals for oxygen uptake.

30263 (TVA/PUB—84/21c, pp 1346-1353) **Regulation of project releases for water quality management.** Holland, J.P. (Army Engineer Waterways Experiment Station, Vicksburg, MS). 1983. NTIS, PC A20/MF A01. File Number DE84007687. (CONF-830939—Vol.3).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

A mathematical simulation methodology is summarized that has been used to develop operational guidance for hydropower projects having reregulation structures and/or pumped-storage capabilities. This methodology combines a one-dimensional reservoir thermal simulation model with a reregulation pool simulation module to predict the thermal characteristics of the reservoir, reregulation pool, and their respective releases for a given set of meteorological, hydrological, and geometrical conditions. From these results, the effects of reservoir and reregulation pool operations, and the effects of changes in these operations, upon project release temperature management may be assessed. An example of the use of this methodology is included.

30264 (TVA/PUB—84/21c, pp 1485-1494) **US dam safety issues.** Bivins, W.S. (Federal Emergency Management Agency, Washington, DC). 1983. NTIS, PC A20/MF A01. File Number DE84007687. (CONF-830939—Vol.3).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

The state of dam safety is not good. Data compiled from the States, the National Program of Inspection of Non-Federal Dams - Final Report to Congress and Federal agencies is used to assess the condition of the Nation's dams. Solutions to the dam safety problems can only come from the efforts of owners as supported by State and Federal government. State programs may not be as strong as first thought. A recently completed study of State programs will provide the basis for assessing the state of nonfederal dam safety programs. Federal programs are proceeding, although at a slow pace. Agency funding is constrained and conditions placed on dam rehabilitation slow action. Increased public awareness and imaginative new State and Federal programs bring hope to an otherwise bleak scene. Federal and State efforts are described, including: financial assistance programs, development of technical assistance and self-help efforts by States.

30265 (TVA/PUB—84/21c, pp 1495-1505) **Hazard ratings and warning systems for dams.** Coxon, R.E. 1983. NTIS, PC A20/MF A01. File Number DE84007687. (CONF-830939—Vol.3).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

Factors related to hazard ratings and warning systems for dams are discussed and information received on current practices in these matters in a number of countries is presented.

30266 (TVA/PUB—84/21c, pp 1506-1511) **Probability based safety assessment of existing dams.** Kreuzer, H.; Bury, K. (Crippen Consultants, N. Vancouver, British Columbia). 1983. NTIS, PC A20/MF A01. File Number DE84007687. (CONF-830939—Vol.3).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

Dam safety is evaluated by examining several distinct load conditions, taking into account their variability. The uncertainty of the dam's resistance is expressed for several resistance modes, and allowance is made to increase these uncertainties for the presence of non-analytical failure causes. The approach taken is probabilistic, but at a level of analysis that makes it easily accessible to the practicing engineer. The purpose of the analysis is to identify the most critical load condition for a given dam and, ultimately, to compare the relative safety within a set of dams.

30267 (TVA/PUB—84/21c, pp 1517-1525) **Auxiliary spillway improves dam safety at minimal cost.** Passage J.T.; Wong, R.M. (Harza Engineering Company, Chicago, IL). 1983. NTIS, PC A20/MF A01. File Number DE84007687. (CONF-830939—Vol.3).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

Nearly 2925 dams were classified unsafe as a result of the National Dam Safety Inspection Program. Inadequate spillway capacity was common deficiency cited. Many owners have been unable to finance construction of additional spillway capacity to meet the recommended federal or state guidelines for spillway design floods because of the high cost of conventional spillway construction. A comparatively economical alternative for providing additional spillway discharge capacity of earth dams is described. The potential benefits are improved safety, construction costs up to 80% less than conventional spillways, and reduce maintenance and liability.

30268 (TVA/PUB—84/21c, pp 1526-1535) **Spillway addition at TVA's Blue Ridge Project.** Spearman, E.L.; Wagner, C.D. (Tennessee Valley Authority, Knoxville). 1983. NTIS, PC A20/MF A01. File Number DE84007687. (CONF-830939—Vol.3).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

TVA, like other State and Federal Agencies, has initiated a program to review its existing dams for conformance to present-day criteria. Because of the deficiency identified and hazards potential, the Blue Ridge Project has the highest priority of 19 TVA dams which were identified as needing further study.

30269 (TVA/PUB—84/21c, pp 1536-1544) **Rapidan hydroelectric project - retrofit of a 70 year old dam.** Spaulding, D.A. (Indeco Inc., Minneapolis MN). 1983. NTIS, PC A20/MF A01. File Number DE84007687. (CONF-830939—Vol.3).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

The retrofit of the 5 MW Rapidan Hydroelectric facility involved technical concerns typical to the renovation of a turn of the century hydro-facility. These concerns included production and revenue modeling, strengthening and rehabilitation of the dam, and the installation of new propeller turbines in a power house originally designed for pressure cased Francis units. As in all renovation projects, the solution to these problems areas was shaped by the specific characteristics of the site. The experience gained at Rapidan in resolving these concerns are discussed.

14 SOLAR ENERGY

30270 (DOE/CS/34039—T1) **Solar Energy Education. Renewable energy activities for junior high/middle school science.** (New York State Dept. of Education, Albany (USA). Solar Energy Project). [1985]. Contract AC01-77CS34039. 102p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE85010359.

Some basic topics on the subject of solar energy are outlined in the form of a teaching manual. The manual is geared toward junior high or middle school science students. Topics include solar collectors, solar water heating, solar radiation, insulation, heat storage, and desalination. Instructions for the construction of apparatus to demonstrate the solar energy topics are provided. (BCS)

30271 (DOE/CS/34039—T2) **[Solar energy education project]. Final technical report, January 1, 1980-December 31, 1983.** (New York State Dept. of Education, Albany (USA). Solar Energy Project). 31 Dec 1983. Contract AC01-77CS34039. 18p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85010358.

During the six-and-one-half years of USDOE funding, the main objectives of the project were: (1) to link teachers and scientists in an endeavor to produce materials on renewable energy, (2) to draft, field-test, and revise those materials, and (3) to disseminate those materials to teachers. In these efforts, the project trained over 100 teachers for curriculum writing; produced materials for grades 6 to 12 for science, industrial arts, home economics, social studies, and the humanities; field tested the materials in 40+ states; revised the best field-tested materials; and worked with the four regional solar energy centers to disseminate the materials throughout the country. Moreover, the effort did not stop in 1983. Under industry funding, the project, (now titled the Energy Education Project), continues an intensive program of teacher training and curriculum development in New York State. At the same time, the materials developed under government funding are being distributed to the extent possible, and are widely used in several states by state education departments and energy education projects.

30272 (DOE/CS/34039—T3) **Solar Energy Education. Humanities: activities and teacher's guide. Field test edition.** (New York State Dept. of Education, Albany (USA). Solar Energy Project). Jan 1982. Contract AC01-77CS34039. 173p. Solar Energy Project, c/o Curriculum Services, New York State Education Dept., Albany, NY 12234. File Number TI85010374.

Activities are outlined to introduce students to information on solar energy while performing ordinary classroom work. In this teaching manual solar energy is integrated with the humanities. The activities include such things as stories, newspapers, writing assignments, and art and musical presentations all filled with energy related terms. An energy glossary is provided. (BCS)

30273 (DOE/CS/34039—T4) **Solar Energy Education. Social studies: activities and teacher's guide. Field test edition.** (New York State Dept. of Education, Albany (USA). Solar Energy Project). Jan 1982. Contract AC01-77CS34039. 138p. Solar Energy Project, c/o Curriculum Services, New York State Education Dept., Albany, NY 12234. File Number TI85010373.

Solar energy information is made available to students through classroom instruction by way of the Solar Energy Education teaching manuals. In this manual solar energy, as well as other energy sources like wind power, is introduced by performing school activities in the area of social studies. A glossary of energy related terms is included. (BCS)

30274 (DOE/CS/34039—T13-Pt.2) **Solar Energy Education. Reader, Part II. Sun story.** (New York State Dept. of Education, Albany (USA). Solar Energy Project). May 1981. Contract AC01-77CS34039. 92p. Solar Energy Project, c/o Curriculum Services, New York State Education Dept., Albany, NY 12234. File Number TI85010366.

Magazine articles which focus on the subject of solar energy are presented. The booklet prepared is the second of a four part series of the Solar Energy Reader. Excerpts from the magazines include the history of solar energy, mythology and tales, and selected poetry on the sun. A glossary of energy related terms is included. (BCS)

30275 (DOE/CS/34039—T13-Pt.4) **Solar Energy Education. Reader, Part IV. Sun schooling.** (New York State Dept. of Education, Albany (USA). Solar Energy Project). May 1981. Contract AC01-77CS34039. 80p. Solar Energy Project, c/o Curriculum Services, New York State Education Dept., Albany, NY 12234. File Number TI85010367.

A collection of magazine articles which focus on solar energy is presented. This is the final book of the four part series of the Solar Energy Reader. The articles include brief discussions on energy topics such as the sun, ocean energy, methane gas from cow manure, and solar homes. Instructions for constructing a sundial and a solar stove are also included. A glossary of energy related terms is provided. (BCS)

1401 Resources And Availability

REFER ALSO TO CITATION(S) 30286, 30410, 30412, 30416, 30440, 31299, 31310

30276 (FRNC-TH—1913) **Contribution to the development of solar and meteorological stations in Senegal: microcomputer controlled measuring station and solar tracking system.** Villain, M. (Toulouse-3 Univ., 31 (France)). 1981. 167p. (In French). NTIS (US Sales Only), PC A08/MF A01. File Number DE85751347.

The problems set by the automatic acquisition and processing of measurements for solar and meteorological stations are first recalled. The solar tracking system developed at the I.U.T. at Dakar is then described; the control of the system is assured by microprocessor. The realization of the data acquisition system is presented in detail. Contents of a meteorological data base are presented. Some data on the solar radiation at Dakar are given. Finally a simulation study of the performance of a solar still is presented.

30277 (IC—84/33) **Techniques for the estimation of global irradiation from sunshine duration and global irradiation estimation for Italian locations.** Jain, P.C. (International Centre for Theoretical Physics, Trieste (Italy)). Apr 1984. 31p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85701229.

Angstrom equation $H=H_0(a+bS/S_0)$ has been fitted using the least-square method to the global irradiation and the sunshine duration data of 31 Italian locations for the duration 1965-1974. Three more linear equations: i) the equation $H'=H_0(a+bS/S_0)$, obtained by incorporating the effect of the multiple reflections between the earth's surface and the atmosphere, ii) the equation $H=H_0(a+bS/S'_0)$, obtained by incorporating the effect of not burning of the sunshine recorder chart when the elevation of the sun is less than 5 deg., and iii) the equation $H'=H_0(a+bS/S'_0)$, obtained by incorporating both the above effects simultaneously, have also each been fitted to the same data. Good correlation with correlation coefficients around 0.9 or more are obtained for most of the locations with all the four equations. Substantial spatial scatter is obtained in the values of the regression parameters. The use of any of the three latter equations does not result in any advantage over that of the simpler Angstrom equation; it neither results in a decrease in the spatial scatter in the values of the regression parameters nor does it yield better correlation. The computed values of the regression parameters in the Angstrom equation yield estimates of the global irradiation that are on the average within +- 4% of the measured values for most of the locations.

30278 **Determination of direct normal solar radiation from measured global values--comparison of models.** Turner, W.D.; Mujahid, A.M. (Department of Mechanical Engineering, Texas A & M University, College Station, Texas). *Journal of Solar Energy Engineering;* 107: No. 1, 39-44(Feb 1985).

The modeling of direct normal solar radiation from measured global solar radiation is discussed and a new direct normal model developed from the Mississippi County Community College solar monitoring station at Blytheville, Ark., is presented. Comparisons of several existing models, including the Aerospace model developed by Randall and Whitson, are made. The Blytheville model and the Aerospace model are compared using five recent solar radiation data bases. The Aerospace model proved to be superior to all the models for the data bases used; however, the Blytheville model was only slightly less accurate and much easier to use. The Blytheville model predicted the beam radiation accurately for several widely varying climatic locations.

30279 **City form: The creation of comfortable urban microclimates.** Brown, G.Z.; Kleczynski, H.; Novitski, B. (Univ. of Oregon, Eugene, OR). pp 531-535 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

This paper describes a method for analyzing the climate of exterior spaces in terms of human thermal comfort. Hypothetical city configurations are compared in two U.S. climate zones.

30280 **Spectral solar radiation - new data.** Hulstrom, R.L. (Solar Energy Research Inst., Golden, CO). pp 917-919 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

Several areas of solar research require an accurate knowledge (data) of the spectral content of solar radiation at the earth's surface for various atmospheric conditions, times during the day (air masses), geographic locations, and for the various seasons (monthly). Areas of solar research include photovoltaics, biomass, materials studies, and solar simulation. As one of its major research thrusts, the Renewable Resource Assessment and Instrumentation Branch (RRAIB) of the Solar Energy Research Institute (SERI, Golden, CO) has been developing improved analytical models, instrumentation, and data sets to meet the various needs for such by the previously mentioned areas of solar energy conversion research. This paper presents a brief summary of selected results of such research. References are given for detailed descriptions of the various individual areas of effort/research and new spectral solar radiation data sets.

30281 **Ashland's energy program from inception to implementation.** Fregonese, J.; Wanderscheid, D. (City of Ashland, Ashland, OR). pp 547-550 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

The City of Ashland is a community of 15,000 people, located along Interstate 5 in southwestern Oregon about 20 miles north of the California border. This paper describes the city's solar access and energy program.

30282 **Deschutes County, Oregon: A unique solar access program.** McKeever, M.R.; Connell, C.W. (Conservation Management Services, Inc., Portland, OR). pp 543-546 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

In May and June, 1983, Deschutes County, Bend and Redmond (Oregon) adopted a comprehensive set of solar access amendments to their zoning and subdivision ordinances. The Deschutes County solar access project is unique in several respects, including: the broad-based cooperative project approach used which led to the concurrent adoption of identical ordinance packages by all three major jurisdictions in the County; the comprehensive commitment to solar access protection from all major shading sources, for new and existing structures, and for all classes of property reflected in the ordinances; and the completion of all of the major administrative and technical documents needed to implement the ordinances. Deschutes County sponsored the project; Conservation Management Services, Inc. (CMS) served as project manager; and the Oregon Department of Energy (ODOE) provided technical assistance. The Bonneville Power Administration (BPA), under the terms of the Northwest Electric Power Planning and Conservation Act (Northwest Power Act), funded the project as a model for other local governments in its four-state service territory.

30283 **Evaluating the solar resource: problems resulting from temporal, spatial and angular variations.** Hay, J.E.; Hanson, K.J. (Univ. of British Columbia, Vancouver, BC). pp 899-915 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

Accurate assessment of the availability of solar energy at the Earth's surface is hampered by difficulties associated with the variability of solar radiation in space and time and with the angular position in the sky hemisphere. This paper assesses each of these problem areas by highlighting the difficulties and the attempts to offset them. Major emphasis is placed on extrapolation and interpolation procedures, the sensitivity of inclined surfaces to variations in the solar input, numerical models for calculating the irradiance of inclined surfaces and the time scales for which these computations are valid. Finally, the reader is urged to consider the significance of these difficulties in light of both radiation measurement errors and the sensitivity of the application to imprecise determinations of the radiation environment.

30284 **The analysis of minute by minute insolation data and its structural implications.** Stewart, R.; Spencer, D. (SUNY, Buffalo, NY). pp 929-933 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

The analysis of minute by minute insolation provides some insight into the magnitude and frequency of impulses created by short-term changes in the insolations. Data of this nature should aid in the development of less costly solar products by eliminating the need for overengineering. Further analysis will provide the relationship between the shortterm changes and specific cloud conditions.

1403 Economics

REFER ALSO TO CITATION(S) 30341, 30354, 30425, 30429, 31297, 31298

30285 **Marketing and technical research: Solar users in Arkansas.** Buford, P.S.; Douglas, D.E. (Arkansas Power & Light Co., Little Rock, AK). pp 471-474 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

The introduction of any new product requires market research sometimes as extensive as the technical research involved in design of the product. This paper describes a study conducted in Arkansas which addresses the two major areas of marketing and technical research.

30286 **An analysis of the benefit-costs of alternative fenestration assemblies for internal-load-dominant buildings noting solar heat gain control and daylighting provisions.** Emery, A.F.; Heerwagen, D.R.; Johnson, B.R.; Kippenhan, C.J. (Univ. of Washington, Seattle, WA). pp 367-372 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

A series of alternative fenestration assemblies for a prototypical office building located in Seattle has been analyzed in terms of energy-efficiency and cost-effectiveness. Three computer programs -UWLIGHT, SUNSXN, and HOUSE -- are exercised to estimate annual energy requirements for supplemental electrical lighting, thermal conditioning, and fan operation. Cost estimates for envelope and mechanical systems and for energy consumption are prepared and compared using a Net-Benefits model. The analysis indicates the greatest profitability for assemblies with heat-reflective or tinted glass.

30287 **The increased use of passive solar energy in single-family dwellings, Colorado Springs, CO.** Grogger, P.K. (Univ. of Colorado, Colorado, Springs, CO). pp 349-353 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

The cost of hydrocarbon energy increased drastically in the early 1970s. Because of a declining resource base, international politics, and an increasing inflation rate, the population of the United States became aware of an energy crisis. The City of Colorado Springs and surrounding communities were more fortunate than many other areas throughout the United States. The cost of energy increased but because of a city-owned public utilities and advantageous contracts the cost of energy to residents remained in the lower 10% of energy costs through the United States. Even so, contractors, developers, local politicians and the average resident wanted to keep energy costs as low as possible. With both gas and electrical pricing increasing due to pass through rate adjustments and changing federal regulations the use of alternative energy sources started to become more common. In Colorado Springs three energy sources became more frequently utilized: (1) electrical generation by wind; (2) active solar with hot water heating the dominant use; and (3) passive solar use for space heating.

30288 **A better understanding of the potential passive solar market.** Bailey, G.; Heibein, S.; Johnson, B.; McLaurin, M.; Nicklas, M.; Parlow, G. (Innovative Design Inc., Raleigh, NC). pp 355-360 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

The following information is presented in an attempt to clarify exactly how passive solar construction can best fit into today's housing market and identify the specific factors that make passive solar a marketable commodity. Informed builders can capitalize on an understanding of the variety of components -- including the general trend toward energy efficiency -- which affect a buyer's decision to purchase a home with solar features.

30289 **Passive solar houses and electric utilities, an impacts analysis.** McCabe, T.F.; Purcell, G.G. (JBF Scientific Corp., Wilmington, MA). pp 373-378 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

In EPRI research project RP1666-1 procedures and methods were developed for determining the thermal performance of passive solar and energy conserving single family detached residential units and their potential utility impacts. These methods were applied to determine the impact of selected penetrations of alternative residential building designs on the loads of four utilities each located in a different climatic zone. Results include a comparison among conventional, energy conserving, and passive solar housing types. The building variation of choice which minimizes the total of homeowner equipment costs and utility energy and demand costs is discussed for each location. Intermediate results on route to the final annualized costs are discussed and compared among the four utilities. It was concluded that passive solar houses can significantly reduce homeowner and utility costs over conventional house designs and can moderately reduce these costs over energy conserving designs in some climates.

30290 Marketing attached greenhouses in an affordable subdivision: Fairway Village, Santa Fe, NM. McAdams, W.; Chapman, M. (Passive Solar Systems, Santa Fe, NM). pp 335-338 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

Fairway Village is a 154-unit middle-income subdivision under construction by Chapman Builders in Santa Fe, New Mexico. Chapman is a traditional, production homebuilder delivering over 100 units a year. Particpants in HUD's and NAHB's Joint Venture for Affordable Housing Demonstration, Fairway Village homes are priced from $49,950 to $69,500 and targeted toward first-time buyers with incomes of $20,000 to $30,000. Designed primarily with affordability in mind, the project offers greenhouse kits which the builder will install as an option. The greenhouse option makes Fairway Village unique among HUD Affordable Housing participants. This paper discusses the process by which a traditional builder attempts to enter the market with an optional solar system, given the tight cost constraints of an affordable subdivision.

30291 Should the sun set on state solar tax credits: an Arizona perspective. Kim, J.; Berkowitz, P.; Johnson, L. (Arizona State Univ., Tempe, AZ). pp 560-566 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

In recent years, tax credit programs have been widely evaluated due to fiscal problems encountered by state and local governments. In Arizona the state solar tax credits could be headed for extinction. Since 1978 Arizonans have received over $40 million in solar tax credits. The number of solar units in that same period exceeds 55,000, the vast majority being residential, domestic hot water applications. This paper presents a brief overview of some of the critical and legitimate issues involved in a solar tax credit analysis. Furthermore, some recommendations from the preliminary results of the cost-benefit analysis of Arizona solar tax credits are described.

1404 Environmental, Legal, And Institutional Aspects

REFER ALSO TO CITATION(S) 30282, 30410

30292 (DOE/CS/30134—T1) [Solar industry standards]. Final technical report. Master, L.W. (ASTM, Philadelphia, PA (USA)). 20 Jun 1984. Contract FG01-78CS30134. 13p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85013134.

In order to accelerate the development of urgently needed standards for solar energy systems, components and materials, funding was designated for activities such as procurement of first draft documents, reimbursement of travel expenses for interim subcommittee and task group meetings, reimbursement of travel expenses for designated consumer representatives, honorariums for consumer-advocate experts and round robin testing. The purpose of this report is to summarize the progress made in the development of standards since 1979, to identify the extent to which funding by the Grant aided in the standards development process and to summarize the expenditures made.

30293 (DOE/CS/34039—T13-Pt.1) Solar Energy Education. Reader, Part I. Energy, Society, and the Sun. (New York State Dept. of Education, Albany (USA). Solar Energy Project). May 1981. Contract AC01-77CS34039. 70p. Solar Energy Project, c/o Curriculum Services, New York State Education Dept., Albany, NY 12234. File Number TI85010368.

A collection of magazine articles which were selected for information on solar energy is presented in this booklet. This booklet is the first of a four part series of the Solar Energy Reader. The articles provide brief discussions on topics such as the power of the sun, solar energy developments for homes, solar energy versus power plants, solar access laws, and the role of utilities with respect to the sun's energy. (BCS)

30294 (PB—85-160067/XAB) CEC (Commission of the European Communities) solar energy modelling: Progress report of the Irish participants of the CEC Modelling Group, 1979/81. Kelledy, E. (Commission of the European Communities, Luxembourg). [1985]. 129p. (EUR—9147-EN). NTIS, PC E07/MF E07.

Prepared in cooperation with Trinity Coll., Dublin (Ireland).

The report describes the activities of the Irish participant in the CEC Solar Energy Modelling Group effort in the period 1980-1981. The background to and objectives of the overall program are described. The development and programming of a solar-system simulation model are discussed in some detail. The sensitivity of this model to changes in major system parameters is examined, and model-predicted system performance measures are compared to real data from Danish, Irish, and Belgian test installations.

1405 Solar Energy Conversion

REFER ALSO TO CITATION(S) 29642, 29665, 29726, 30059, 30062, 30063, 30064, 30069, 30070, 30071, 30072, 30073, 30074, 30077, 30078, 30079, 30080, 30082, 30083, 30086, 30087, 30336, 30344, 30544, 30548, 30556, 31374, 31635, 31686, 31687, 31749, 32216, 32281

30295 (BNL—36577) Improved blue response and efficiency of A-Si:H solar cells deposited from disilane using a dual-chamber plasma system. Rajeswaran, G.; Vanier, P.E.; Corderman, R.R.; Kampas, F.J. (Brookhaven National Lab., Upton, NY (USA)). 1985. Contract AC02-76CH00016. 10p. (CONF-851043—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE85013289.

From 18. IEEE photovoltaic specialists conference; Las Vegas, NV, USA (21 Oct 1985).

Thin film amorphous silicon solar cells with glass/SnO$_2$/p/i/n/Al structures and 6 to 7% AM1 conversion efficiencies were fabricated at rapid deposition rates in a newly constructed dual-chamber glow discharge deposition system. The 500 nm thick intrinsic layer was deposited at the rate of 1.7 nm/s using disilane (Si$_2$H$_6$)-helium mixtures. This deposition rate is an order of magnitude greater than conventional high efficiency amorphous silicon solar cell depositions. Residual boron doping effects at the p/i interface can severely degrade cell performance particularly when the intrinsic layer is deposited in one chamber of the dual-chamber system and the intrinsic layer is deposited in the other chamber that is free of boron contaminants. Parameters such as electrode spacing, Si$_2$H$_6$ partial pressure and flow rate were optimized to produce uniform deposition over large areas. At the substrate temperature T/sub s/ selected for solar cell intrinsic layer deposition, the spin density was measured to be a minimum at 5 x 10^{15}/cm^3. For a given T/sub s/, an intrinsic layer deposited from Si$_2$H$_6$ absorbs fewer photons and can generate less current under solar simulation than a similar film produced from monosilane. Identical solar cells were deposited in either the single-chamber mode or the dual-chamber mode for comparison. Single-chamber mode cells perform poorly over the visible wavelengths and hence produce low short circuit currents. The dual-chamber mode cells show a significant improvement in blue response and a factor of two increase in short circuit current over the single-chamber mode cells. Under short circuit conditions, 15 mA/cm^2 was generated from rapidly deposited (1.7 nm/s) cells from disilane and 18 mA/cm^2 from low deposition rate (0.18 nm/s) monosilane cells. These values are comparable to or better than those reported for similar cells by other groups.

30296 (CONF-850307—1) Short-radiation woody crops production research in the South. Ranney, J.W.; Trimble, J.L.; Wright, L.L.; Perlack, R.D. (Oak Ridge National Lab., TN (USA)). Mar 1985. Contract AC05-84OR21400. 17p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85011411.

From 3. Southern biomass energy research conference; Gainesville, FL, USA (12 Mar 1985).

National priorities for research on short-rotation woody crops as energy feedstock are set to achieve economic competitiveness with alternative energy and forest product feedstocks. Present estimates of production costs vary from \$3.50 to \$8.00/GJ of usable heat (i.e., after conversion by direct combustion). Therefore, based on research results, short-rotation-derived feedstocks may soon be competitive in some locations with most other fuels, except wood wastes and coal. However, further cost reductions under operating conditions are still necessary for wide concept utilization. These reductions can best be accomplished through genetic improvements of species development of more efficient harvesting methods and equipment, and utilization of optimum cultural techniques. These topics are discussed with some specific references to the South to more specifically portray the state-of-the-art of short-rotation woody crops for energy. Ultimate costs of production could be \$2.75 to \$5.00/GJ of usable heat or about \$15/green Mg (\$30/dry Mg), while productivity rates could reach 9 to 15 dry M ha^{-1} $year^{-1}$ on many sites. 17 refs., 3 figs., 3 tabs.

30297 **(DOE/CE—0106) Photovoltaics technology program summary.** (Conservation and Renewable Energy Inquiry and Referral Service, Silver Spring, MD (USA)). May 1985. Contract AC01-83CE30780. 5p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85013098.

FS 194, 1st Edition.

30298 **(DOE/CS/34039—T7) Solar Energy Education. Renewable energy activities for biology.** (New York State Dept. of Education, Albany (USA). Solar Energy Project). 1982. Contract AC01-77CS34039. 63p. NTIS, PC A04/MF A01; GPO Dep. File Number DE85010370.

An instructional aid for teachers is presented that will allow biology students the opportunity to learn about renewable energy sources. Some of the school activities include using leaves as collectors of solar energy, solar energy stored in wood, and a fuel value test for green and dry woods. A study of organic wastes as a source of fuel is included. (BCS)

30299 **(DOE/ER/04927—T5) Mechanisms of photochemical energy conversion by chlorophyll. Technical progress report, March 1, 1983-March 1, 1985.** Tollin, G. (Arizona Univ., Tucson (USA). Dept. of Biochemistry). 1985. Contract AC02-78ER04927. 8p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85012535.

Highlights of progress achieved during the period from March 1, 1983-March 1, 1985 are briefly summarized. The results from 4 projects are reported. Electrostatic effects on electron transfer using both charged and uncharged bilayer vesicles and using cholesterol were investigated. The effects of acceptor solubility on photosensitized electron transfer reactions were probed using viologen derivatives. Correlation was made between the efficiency of charge separation and the rate of escape of viologen radical from the membrane to the aqueous phase. The study demonstrates that the kinetics of photosensitized electron transfer reactions in vesicle systems can be controlled by adjusting the solubility properties of the quencher. The kinetics are also sensitive to electrostatic effects at the interface. (DMC)

30300 **(DOE/JPL/954527—27/84) Investigation of test methods, material properties, and processes for solar cell encapsulants. Eighth annual report.** Willis, P.B. (Springborn Labs., Inc., Enfield, CT (USA)). 1985. Contract NAS-7-100-954527. 101p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE85012831.

The historical development of ethylene-vinyl acetate (EVA) is presented, including the functional requirements, polymer selection, curing, stabilization, production and module processing. The construction and use of a new method for the accelerated aging of polymers is detailed. The method more closely resembles the conditions that may be encountered in actual module field exposure and additionally may permit service life to be predicted accurately. The use of hardboard as a low cost candidate substrate material is studied. The performance of surface anti-soiling treatments useful for imparting a self-cleaning property to modules is updated. (LEW)

30301 **(DOE/JPL/956312—11) Stress and efficiency studies in EFG. Quarterly progress report, January 1, 1985-March 31, 1985.** (Mobil Solar Energy Corp., Waltham, MA (USA)). 15 May 1985. Contract NAS-7-100-956312. 42p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85013589.

Detailed EBIC characterization of stressed FZ and CZ silicon of varying oxygen and carbon levels has been carried out. The bulk diffusion lengths are limited by point defect recombination to about 15 to 25 microns in dislocation-free regions after the high temperature (>1200°C) heat treatment and stress application. Increases in dislocation density from $1 \times 10^4/cm^2$ to over $1 \times 10^7/cm^2$ further decrease the diffusion length to the range 10 to 15 microns. One-hour anneals at 575°C and 850°C produce little increase in diffusion length, at most by a factor of two, while preferential gettering at dislocations is weak. Significant differences in silicon with varying oxygen and carbon levels are not observed. Four-point bending has been carried out at 1000°C and lower to provide more samples to continue the studies on electrical activity of dislocations. Several modified afterheater shield configurations were tested in Furnace 17 and ribbon was grown to attempt to minimize dislocation densities. Stress distribution profiles are also being calculated for some growth configurations. The stress modeling at Harvard University has been directed toward implementing a new scheme for calculating residual stress, which has important implications for understanding creep and strain relationships to residual stress.

30302 **(DOE/SF/12200—T1) Radiant solid phase decomposition studies. Technical status report.** T-Raissi, A. (Hawaii Univ., Honolulu (USA). Hawaii Natural Energy Inst.). Jun 1985. Contract AC03-84SF12200. 28p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85013587.

In this report, recent results of research concerned with fundamental studies of the high temperature solid phase decomposition of zinc sulfate at low and high heating rates are presented. The low heating rate studies were carried out using a conventional thermogravimetric system (Setaram Simultaneous TGA/DTA unit). The high heating rate results were obtained in a novel, Fast-TGA system capable of rapidly weighing materials exposed to concentrated radiant energy derived from an arc image furnace. The goal of this work is to identify unique effects of radiant heating on the decomposition behavior of zinc sulfate. This report presents a set of low heating rate results and compares them to those of other investigators. While the fundamental low heating rate studies of solid phase decomposition using conventional thermal analysis systems is now routine, very few instruments are currently available to study these processes under high temperature (>2000°C), high radiative flux (up to 1000 W/cm^2) environments similar to that of a solar furnace. Typical decomposition results obtained from intense radiative heating of zinc sulfate are presented and discussed in conjunction with the design of a novel thermogravimetric system.

30303 **(FRNC-TH—1880) Characterization of defects in InSe. Application to the photovoltaic conversion.** Houdy, P. (Paris-7 Univ., 75 (France)). 1982. 134p. (In French). NTIS (US Sales Only), PC A07/MF A01. File Number DE85751584.

One studies the method for growing InSe crystals and the problems of doping and annealing. The characteristics of different types of InSe solar cells are examined. The diffusion mechanisms which come into effect at different temperatures are described, and a proposition of a two dimensional defect model is presented. Electron microscopy allows to observe surface defects and two dimensional macroscopic defects. The effect of impurities on the excitonic peak of InSe is finally considered.

30304 **(FRNC-TH—1884) Contribution to the development of a pilot manufacturing line of Cu_2S-CdS film solar cells using the chemical reactive spray method.** Maris, O. (Montpellier-2 Univ., 34 (France)). 1980. 113p. (In French). NTIS (US Sales Only), PC A06/MF A01. File Number DE85751585.

Each step in the fabrication of these cells is studied, as also the evolution of each step up to the present time. This evolution is examined in terms of the results obtained for each particular configuration of the manufacturing line. Problems concerning series contact resistance and problems posed by electrodes are studied. The move towards greater surface areas is considered along with cell stability.

30305 (LBL—19374) Fuel oils from higher plants. Calvin, M. (Lawrence Berkeley Lab., CA (USA)). Mar 1985. Contract AC03-76SF00098. 31p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85013187.

A summary of the types of plants available for converting solar energy to fuel and materials on an annually renewable basis is presented. Sugar cane, seed oils, herbaceous plants (Hevea, Euphorbia, Asclepias), hydrocarbon producing trees (Eucalystus globulus, Pittosporum, Copaifera), and algae are discussed. Emphasis is placed on the development of "energy agriculture" and the use of plants to synthesize hydrocarbon-like materials especially in the less developed areas of the world. (DMC)

30306 (N—85-16294) Results of the 1984 NASA/JPL balloon flight solar cell calibration program. Downing, R.G.; Weiss, R.S. (Jet Propulsion Lab., Pasadena, CA (USA)). Oct 1984. 17p. (NASA-CR—174270; JPL-PUBL—84-65). NTIS, PC A02/MF A01.

The 1984 solar cell calibration balloon flight was successfully completed on July 19, meeting all objectives of the program. Thirty-six modules were carried to an altitude of 36.0 kilometers. The calibrated cells can now be used as reference standards in simulator testing of cells and arrays.

30307 (N—85-16295) Multijunction cells for concentrators: technology prospects. Ferber, R.R.; Costogue, E.N.; Shimada, K. (Jet Propulsion Lab., Pasadena, CA (USA)). Nov 1984. 50p. (NASA-CR—174259; JPL-PUBL—84-71). NTIS, PC A03/MF A01.

Development of high-efficiency multijunction solar cells for concentrator applications is a key step in achieving the goals of the U.S. Department of Energy National Photovoltaics Program. This report summarizes findings of an issue study conducted by the Jet Propulsion Laboratory Photovoltaic Analysis and Integration Center, with the assistance of the Solar Energy Research Institute and Sandia National laboratoies, which surveyed multijunction cell research for concentrators undertaken by federal agencies and by private industry. The team evaluated the potentials of research activities sponsored by DOE and by corporate funding to achieve projected high-efficiency goals and developed summary statements regarding industry expectations. Recommendations are made for the direction of future work to address specific unresolved aspects of multijunction cell technology.

30308 (N—85-16302) Demonstration of transparent solar array module design. Final report. Pack, G.J. (Lockheed Missiles and Space Co., Inc., Sunnyvale, CA (USA); Jet Propulsion Lab., Pasadena, CA (USA)). Sep 1984. 79p. (NASA-CR—174257). NTIS, PC A05/MF A01.

This report discusses the design, development, fabrication and testing of IR transparent solar array modules. Three modules, consisting of a baseline design using back surface reflector cells, and two modules using gridded back contact, IR transparent cells, were subjected to vacuum thermal balance testing to verify analytical predictions of lower operating emperature and increased efficiency. As a result of this test program, LMSC has verified that a significant degree of IR transparency can be designed into a flexible solar array. Test data correlates with both steady state and transient thermal analysis.

30309 (N—85-17364) Automated assembly of Gallium Arsenide and 50-micron thick silicon solar cell modules. Mesch, H.G. (TRW Space Technology Labs., Redondo Beach, CA (USA)). Dec 1984. 23p. (NASA-CR—174331). NTIS, PC A02/MF A01.

The TRW automated solar array assembly equipment was used for the module assembly of 300 GaAs solar cells and 300 50 micron thick silicon solar cells (2 x 4 cm in size). These cells were interconnected with silver plated Invar tabs by means of welding. The GaAs cells were bonded to Kapton graphite aluminum honeycomb graphite substrates and the thin silicon cells were bonded to 0.002 inch thick single layer Kapton substrates. The GaAs solar cell module assembly resulted in a yield of 86% and the thin cell assembly produced a yield of 46% due to intermittent sticking of weld electrodes during the front cell contact welding operation. (Previously assembled thin cell solar modules produced an overall assembly yield of greater than 80%).

30310 (SAND—85-0791/1) Photovoltaic Concentrator Technology Project. Thirteenth project integration meeting. (Sandia National Labs., Albuquerque, NM (USA)). May 1985. Contract AC04-76DP00789. 282p. (CONF-8506140—Absts.). NTIS, PC A13/MF A01; 1; GPO Dep. File Number DE85013253.

From 13. photovoltaic concentrator project integration meeting; Albuquerque, NM, USA (4 Jun 1985).

This report is the Proceedings for a meeting on Photovoltaic Concentrator Technology held in Albuquerque, NM on June 4 and 5, 1985. The meeting covered research on photovoltaic concentrators and their components, including concentrator cells, cell assemblies, fresnel lenses, concentrator modules, tracking structures and control systems, and complete concentrator arrays. This report contains abstracts of presentations made at the meeting and status reports for current research contracts. This report is a companion to SAND-85-0791/2 which contains summaries of the more important findings presented at the Project Integration Meeting.

30311 (SERI/CP—211-2682) 1985 amorphous silicon review meeting. (Solar Energy Research Inst., Golden, CO (USA)). Mar 1985. Contract AC02-83CH10093. 322p. (CONF-8503106—). NTIS, PC A14/MF A01; 1; GPO Dep. File Number DE85008794.

From Amorphous silicon subcontractors annual review meeting; Washington, DC, USA (21 Mar 1985).

Separate abstracts were prepared for 32 papers in this meeting proceedings. One other paper had been previously abstracted for EDB. (LEW)

30312 (SERI/PR—212-2634) Solid/melt interface studies of high-speed silicon sheet growth. Final technical progress report, July 15, 1983-July 15, 1984. Ciszek, T.F. (Solar Energy Research Inst., Golden, CO (USA)). Feb 1985. Contract AC02-83CH10093. 67p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85008783.

Radial growth-rate anisotropies and limiting growth forms of point-nucleated, dislocation-free silicon sheets spreading horizontally on the free surface of a silicon melt have been measured for (100), (110), (111), and (112) sheet planes. Analysis of the sheet edges has led to predicted geometries for the tip shape of unidirectional, dislocation-free, horizontally growing sheets propagating in various directions within the above-mentioned planes. Feasibility was demonstrated for a crucible-free horizontal (CFH) ribbon growth method. High-purity, cold-crucible melt confinement was used to grow silicon sheets by edge-supported pulling (ESP). Quartz capillary filaments were used. Solar cell data on these sheets are presented. Also cell, lifetime, mobility, spreading resistance, x-ray topography, and neutron activation analysis data were obtained for dislocation-free cylindrical ingots of [111] and [100] orientation. We conducted x-ray topography analysis of dendritic web silicon sheets, and the resultant topographs are presented in this report. A possible correlation between slip dislocations and web cell efficiency was seen. Float zoning studies were initiated for high-purity, dislocation-free silicon to be applied to high-efficiency silicon solar cells.

30313 (SERI/STR—211-2607) Photovoltaic devices using hydrogenated amorphous silicon produced by the chemical vapor deposition of higher order silanes. Final report, 1 August 1982-31 August 1983. Delahoy, A. (Chronar Corp., Princeton, NJ (USA)). Apr 1985. Contract AC02-83CH10093. 39p. NTIS, PC A03. File Number DE85008810.

This report presents the results of work performed to explore the properties of hydrogenated amorphous silicon (a-Si:H) produced by the chemical vapor deposition (CVD) of higher order silanes. The higher silanes were produced by a chemical method and by silent electric discharge of CCD-grade monosilane. The latter method yields a high-purity mixture of higher silanes. The a-Si:H films were deposited mainly from silane by a static CVD method: the heated reactor was purged and evacuated and then filled to the initial pressure desired with reactant gases. The extent of the deposition chemistry was monitored by the increase in pressure. At a predetermined increase in pressure, the system was quickly evacuated. This process was repeated several times to obtain a film of the desired thickness. These experiments were performed to increase our understanding of the deposition mechanism of a-Si:H, to improve the quality of CVD a-Si:H layers for device applications, to measure the properties of CVD a-Si:H doped and undoped layers, and to explore new device structures and alternative CVD techniques.

30314 **(SERI/STR—211-2675) Research on high-efficiency, single-junction, monolithic, thin-film amorphous silicon solar cells. Annual report, 1 December 1983-30 November 1984.** Ashton, G.R.; Aspen, F.E.; Epstein, K.A.; Jacobson, R.L.; Jeffrey, F.R.; Patel, R.I.; Shirck, J.R. (Minnesota Mining and Mfg. Co., St. Paul (USA). Electronic and Information Sector Labs.). Apr 1985. Contract AC02-83CH10093. 93p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85008809.

The design and construction features of a monolithic, series-connected, amorphous silicon solar cell are presented in this report. Each large-area individual cell was to measure 0.5 cm x 10.0 cm. The technology and systems capabilities of continuous, large-area deposition onto flexible substrates are important to the successful commercialization of thin-film a-Si solar cells, to minimize two of the major factors that influence the overall manufacturing cost of amorphous silicon photovoltaic devices: capital costs and substrate handling costs. Capital costs should be minimized by systems that operate continuously, and substrate handling costs should be minimized by maximizing substrate size. Two basic design concepts for deposition chambers are discussed. One uses an in-line deposition configuration and the other employs a rotating drum that transports the web.

30315 **(SERI/TR—215-2484) Resource evaluation and site selection for microalgae production systems.** Maxwell, E.L.; Folger, A.G.; Hogg, S.E. (Solar Energy Research Inst., Golden, CO (USA)). May 1985. Contract AC02-83CH10093. 98p. NTIS, PC A05/MF A01; GPO Dep. File Number DE85008807.

Climate, land, and water resource requirements of microalgae production systems (MPS) were examined relative to construction costs, operating costs, and biomass productivity. The objective was the stratification of the southwestern United States into zones of relative suitability for MPS. Maps of climate (insolation, freeze-free period, precipitation, evaporation, thunderstorm days), land (use/cover, ownership, slope), and water (saline groundwater) resource parameters were obtained. These maps were transformed into digital overlays permitting the cell-by-cell compositing of selected resource parameters to form maps representing relative productivity, make-up water, climate suitability, land suitability, water suitability, and overall suitability. The Southwest was selected for this study because of its high levels of insolation, saline water resources, and large areas of relatively low valued land. The stratification maps cannot be used for the selection of specific sites because of their low resolution (12,455-acre cells). They can be used to guide future resource studies and site selection efforts, however, by limiting these efforts to the most suitable regions. Future efforts should concentrate on saline water resources, for which only limited data are currently available. 13 refs., 44 figs., 5 tabs.

30316 **(SLU-LBT—129) Straw burning plants. Operation experiences from six farms 1981/82 and 1982/83.** Ivarsson, E. (Swedish Univ. of Agricultural Sciences, Lund. Dept. of Farm Buildings). Sep 1983. 115p. (In Swedish). (STU—80-5503). NTIS (US Sales Only), PC A06/MF A01. File Number DE85750870.

One of the main purposes of the project was to study a number of straw burning plants practically. Observations and registrations were made to determine the following factors: 1) Time required to handle the straw, to control and run the plant. 2) Furnace efficiency and operation. 3) Amount of ash. The determination of furnace efficiency was based on the effective calorific value of the straw, the amount of straw fed and the output energy of the furnace. By this the accurate determination of the moisture content of the straw fed is of great importance for the final results.

30317 **(STEV-EO—83-13) Energy Forest. Experiment on a large scale Domaen. Progress report 2.** Eden, P. (Statens Energiverk, Stockholm (Sweden)). 1983. 100p. (In Swedish). NTIS (US Sales Only), PC A05/MF A01. File Number DE85750814.

The experiment is being executed on a large bog of 85 hectare called Finnmossen, 30 km north Vaesterass. The aim of the project is to carry out a practical experimental cultivation of energy forest, to enable all aspects of the chain, from choice of land and the establishing of the cultivation through to harvesting and the final utilization, to be included. The project was started April 1979 and its 4 stages are planned to Dec 1987. The resources included 16584000 SEK. This report forms an account of the project establishment stage which is No. 2. Nearly 2 million cuttings and plants of the Salix family have been planted. A special basic vehicle, having a very low ground pressure, and a special deep harrowing machine which can deposit lime to a depth of 0.45 m in the cultivated rows are being developed. A new idea to regulate water in the ditches has been tested. Different clones show large variations concerning growth and degree of hardiness. The general estimate for the total establishment lies in the region of 14500 to 20000 SEK per hectare. Stage 2 shows that economically justifiable methods and systems for the establishment of energy forest can be found.

30318 **(STEV-EO—84-4) Technical systems in energy forestry.** Noren, O.; Danfors, B.; Stambeck, A. (Statens Energiverk, Stockholm (Sweden)). 1984. 145p. (In Swedish). (JTI—53). NTIS (US Sales Only), PC A07/MF A01. File Number DE85750839.

Cost examples and performance data referring to different kinds of machinery inputs are given, e.g., for soil treatment and weed control. A short description is then given of requirements on soil types, shapes of fields, etc. The off-road mobility of machinery and vehicles in this connection is of exceptionally great importance both during the summer and winter as planting and management take place during the summer and the harvest during the winter. Snow conditions in Sweden (depth, density and mass) have been studied in detail and a special appendix describes snow conditions at several places. The different work operations and equipment required in connection with planting, management and harvest of energy forests are discussed in chronological order. As examples can be mentioned clearing of vegetation, draining, stone clearing and soil tillage. Examples of operations where special inputs will be required to develop techniques and equipment are planting of cuttings and weed control in new and growing stands. Off-road mobility and risk of damage to the soil surface will require development of, in some cases, advanced wheel or track equipment. The harvesting of energy forests has been surveyed. The handling, drying and storage of the harvest have been discussed. Harvesting, storage and distribution of cuttings will require developmental work. The planting, management and harvest of energy forests requires certain amount of service and requirements in the form of, e.g., fuel, spare parts and equipment for hauling or winching out bogged-down machinery. In general it is observed that available technique and equipment can easily be adapted for certain work operations in energy forestry. In other cases there will be a need for development of basic data and development of new techniques if energy forestry is to be able to be conducted to any greater extent and to be competitive.

30319 **(STEV-SB—84-1) Progress report fiscal year 1982/83, Forest Energy Project.** Nilsson, P.O. (Statens Energiverk, Stockholm (Sweden)). Sep 1983. 53p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. File Number DE85750845.

With the Forest Energy Project publication list 61 ref.

The Forestry Energy Project at the Swedish University of Agriculture Sciences started in 1977 with the objective to develop necessary knowledge for an increased use of wood fuel in Sweden in order to substitute imported oil. The aim is to describe and analyse systems and machine components to be used in harvesting, transportation, storage and conversion of various forestry resources, such as logging residues - tops, branches and stumps from clear cuts - and small trees from thinnings. The systems shall be applicable to demands posed by different categories of forest owners and be designed with consideration to good economy, high availability, and the demand for good working conditions as well as the conservation of nature. The project is financed by the National Swedish Board for Energy Source Development, the total support for the six years July 1977-June 1983 being 23.5 million Swedish Crowns.

30320 Chemical vapor deposition of boron-doped hydrogenated amorphous silicon. Ellis F.B. Jr.; Delahoy, A.E. (Chronar Corporation, Princeton, New Jersey 08542). *Applied Physics Letters;* **47**: No. 2, 135-137(15 Jul 1985).

Deposition conditions and film properties for a variety of boron-doped hydrogenated amorphous silicon films and silicon-carbon films produced by chemical vapor deposition (CVD) are discussed. Deposition gases include monosilane, disilane, trisilane, and acetylene. Two types of optically wide band-gap p layers are obtained. One of these window p layers (without carbon) has been extensively tested in photovoltaic devices. Remarkably, this p layer can be deposited between about 200 to 300 °C. A typical open circuit voltage in an all CVD p-i-n device is 0.70—0.72 V, and in a hybrid device where the i and n layers are deposited by glow discharge, 0.8—0.83 V.

30321 Process-induced defects in solar cell silicon. Gleichmann, R.; Cunningham, B.; Ast, D.G. (Department of Materials Science and Engineering, Bard Hall, Cornell University, Ithaca, New York 14853). *Journal of Applied Physics;* **58**: No. 1, 223-229(1 Jul 1985). Contract AC02-76ER02899.

The microstructure of as-grown and processed, edge-defined film-fed grown, silicon ribbons was studied in order to identify the basic mechanisms responsible for the change of the as-grown defect structure during processing at elevated temperatures. The short heat treatment required to diffuse the p-n junction was sufficient to cause heterogeneous precipitation of impurity atoms, particularly transition metals. In addition, an elastic recovery of the ribbon occurred by dislocation glide, resulting in the formation of a polygonizationlike structure of sub boundaries in the base. Mechanism are suggested by which twin boundaries, acting as dislocation obstacles, can concentrate the relatively low average dislocation densities typical of edge-defined film-fed grown ribbons (10^4 cm^{-2} to 10^6 cm^{-2}) to values which are sufficient to induce the formation of subgrain-like boundary structures.

30322 Photoconductivity and electronic doping effects in hydrogenated amorphous silicon. McMahon, T.J.; Madan, A. (Solar Energy Research Institute, 1617 Cole Blvd., Golden, Colorado 80401). *Journal of Applied Physics;* **57**: No. 12, 5302-5305(15 Jun 1985). Contract AC02-83CH10093.

The concept of electronic doping is used to explain unexpectedly large values of the diode quality factor (exceeding two) and supralinearity which is sometimes observed in amorphous silicon p-i-n-type diodes and materials, respectively. This suggests the presence of an extra set of defect states in lightly boron-doped films with a capture rate for electrons which is much larger than that of the inherent defect states. We also report that for high-quality undoped intrinsic layers, the photoconductivity versus intensity behavior exhibits sublinear power dependence which increases with intensity in distinct contrast to the previously reported results. We provide a self-consistent model which is able to explain the above observations.

30323 Recent results on hydrogen passivation of silicon sheet solar cells. Tsuo, Y.S.; Milstein, J.B. (Solar Energy Research Institute, Golden, Colorado 80401). *Journal of Applied Physics;* **57**: No. 12, 5523-5524(15 Jun 1985). Contract AC02-83CH10093.

Recent experiments have shown that the fill factor degradation of some hydrogen-passivated dendritic web solar cells we reported earlier [Y. S. Tsuo and J. B. Milstein, Appl. Phys. Lett. 45, 971 (1984)] is caused mainly by thin (less than 7 μm), damaged, front metal grids. A comparison of spectral response data for unpassivated and passivated cells shows that improvements occur mainly in the longer wavelength region, which indicates that bulk properties are enhanced by hydrogen passivation. We have also examined the stability of hydrogen-passivated dendritic web solar cells over a three month period under outdoor test conditions and have not found any degradation. Electron-beam-induced current data have been obtained that show the hydrogen passivation of dislocations as well as grain boundaries in edge-supported-pulling silicon sheet solar cells.

30324 Opportunities for high efficiency amorphous silicon thin film solar cells. Madan, A. (Chevron Research Co., Richmond, CA). pp 855-860 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

Amorphous silicon based alloys have attracted a considerable amount of interest in the past few years because of their potential as inexpensive solar cells. The highest conversion efficiency so far reported exceeds 10%. However, some recent economic studies suggest that for a viable photovoltaic market, thin film solar cells would have to attain still higher conversion efficiencies. The authors review some of the basic properties of amorphous silicon based alloys and consider the multijunction stack arrays which provide a route toward the attainment of higher efficiencies.

30325 Annual performance analysis of series and independently connected A1GaAs/silicon stacked cells. King, D.L.; Siegel, R.B. (Sandia National Labs., Albuquerque, NM). pp 921-928 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

An analytical capability for calculating the annual performance of stacked, multijunction, multibandgap solar cells has been developed. Daily, site dependent variations in atmospheric air mass, turbidity and precipitable water were included in the model. The optimum bandgap combination for a two cell stack was about1.75 eV for the top cell and about1.1 eV for the bottom. An A1GaAs cell on a Si cell could provide this combination. This bandgap combination was optimum for both series and independently connected cells, and was also reasonably independent of the site evaluated. By using this combination, the annual penalty for series connecting the cells was less than 2% for typical Albuquerque atmospheric conditions. For ideal cell performance assumptions, the calculated annual efficiency at 200 suns illumination was approximately 41%. Using measured spectral response and cell transmittance data, representative of current cell technology, resulted in a calculated annual efficiency at 200 suns of approximately 25%.

30326 Fluorescence sensitization and quenching in a particulate chlorophyll model system. Seely, G.R.; Senthilathipan, V. (C.F. Kettering Research Lab., Yellow Springs, OH). pp 793-796 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

The success of photosynthesis as an energy conversion process is largely owing to the manner in which the light-gathering and reaction center pigments are arranged within the thylakoid membrane. A particularly important condition in the construction of model systems based on these pigments is the need to avoid quenching of fluorescence until useful electron transfer takes place. In the model system under investigation, concentration quenching of chlorophyll is prevented by embedding the pigment molecules, along with certain amphiphiles, in the viscous hydrocarbon surface layer of swollen particles of polyethylene. Triplet state photoreactivity of chlorophyll on these particles can readily be demonstrated. Quinones such as Vitamin K_1 do not quench the fluorescence of chlorophyll even when incorporated at high concentration in the particles. But specially made amphiphiles, containing an amide group to ligate the Mg of chlorophyll, and a reducible group such as quinone, quench the fluorescence even at modest concentrations. The photochemistry of these systems is under investigation.

30327 Dendritic web photovoltaic module performance. Rose, C.M. (Westinghouse Electric Corp., Pittsburgh, PA). pp 817-824 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

This paper contains a description of the design features of the dendritic web photovoltaic modules intended to achieve long life, low degradation performance. The design goal of the modules is a 20 year life with less than 5% performance degradation. A sufficient number of dendritic web photovoltaic modules have been built to allow an initial evaluation of routine performance levels and endurance characteristics of the design. Most of the data is related to accelerated endurance tests performed by the Jet Propulsion Laboratory to simulate 20 year life operation. In addition to these tests, actual operational data generated over a two year period by Pacific Gas and Electric Corporation indicates an as-yet unmeasurable amount of degradation. Based on these tests, it is concluded that dendritic web modules can achieve the endurance lifetime and degradation goals when operated under typical anticipated environmental conditions.

30328 EFG photovoltaic modules: construction and field experience. Tornstrom, E. (Mobil Solar Energy Corp., Waltham, MA). pp 825-830 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

Mobil Solar has been manufacturing photovoltaic modules since 1978 and has had field installations since 1980. Module manufacturing methods and techniques have improved from a double glass silicone potting encapsulation to an EVA foil barrier lamination. Cell interconnection has progressed from an expanded copper mesh to a redundant copper tab system. External module connections have advanced from simple insulated flat copper strips exiting from the module sides to completely encapsulated power buses terminating at a multi-purpose weatherproof junction box. Mobil Solar has introduced the first large area module with high voltage capabilities for residences and intermediate load centers. Over the past 3 years, module areas have increased from 3 ft^2 to over 23 ft^2.

30329 Short rotation woody crops program. Ranney, J.W. (Oak Ridge National Lab., TN). pp 52 of Proceedings of the 1982 southern forest working group workshop. New Orleans, LA; Southern Forest Experiment Station (1982).

This program is concerned with new wood production techniques that attain high productivity levels. Sometimes known as short-rotation intensive culture, experimentation is concentrating on hardwood tree species that stump sprout and can be re-harvested every 3 to 10 years. Research focuses on the screening of fast-growing species and techniques of short-rotation wood crop management, although plant propogation, new wood recovery systems, and economic evaluations are within the scope of the program. The program's objective is to attain high productivity rates at competitive prices. Production systems vary across the United States depending on environment, species, and economic competition for resources. The major requirements of short-rotation intensive culture are improved stock, weed and pest control, fertilization, and sites of at least marginal quality for agriculture. Irrigation should generally be avoided for increasing productivity. Harvest and transport costs make up the greatest cost component of the system. In some locations it appears that short-rotation intensive culture is immediately competitive as an energy feedstock, although industrial acceptance is low. The concept of short-rotation intensive culture is being subjected to intense scrutiny to determine its viability and capability for improvement. Sensitivity analysis and/or field testing at over 30 universities and institutions are, or have been, under way, with significant results now coming to light. The concept is being tested to assist public/industrial evaluation and possible use as an energy source. Benefits for other uses are recognized as high.

30330 Emergent aquatic plants: biological and economic perspectives. Kresovich, S.; Wagner, C.K.; Scantland, D.A.; Lawhon, W.T. (Battelle Columbus Labs., OH). *Biomass;* **1:** 127-144(1981).

One of the most productive, but least exploited, biomass resources is the group classified as the emergent aquatic plants. Information is presented concerning the biological and economic factors that must be considered if emergent aquatic plants are to become viable feedstocks for multipurpose systems. The feedstock purposes highlighted include fuel and/or chemical production and the species identified as potential candidates for production in biomass systems include Arundo donax, Cyperus papyrus, Phragmites communis, Saccharum spontaneum, Spartina alterniflora, and Typha latifolia. If these species are to be viable candidates in biomass systems, a number of research areas must be investigated further. Issues such as the development of base-line yield data for managed systems, mechanization and harvesting conceptualization, genetic (crop) improvement, identification of secondary plant products, and economic considerations require refinement. However, the potential pay-off for developing emergent aquatic systems will be significant if successful. 19 references.

1406 Photovoltaic Power Systems

REFER ALSO TO CITATION(S) 30297, 30527

30331 (DOE/CE/30701—T1) SMUDPV1 quarterly performance report II, January-March 1985. Rosen, D. (Sacramento Municipal Utility District, CA (USA); Acurex Corp., Mountain View, CA (USA)). May 1985. Contract FC03-82CE30701. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85012802.

The performance of the photovoltaic plant is documented for the months of January, February, and March 1985. Performance trend data are given which provide relevant plant performance and weather data on a daily basis for the reporting period. Weather data, array performance, power conditioning unit performance, and net plant performance are graphed. Also discussed are specific operating and maintenance problems, their effect on plant operating time, and efforts conducted to resolve them. (LEW)

30332 (DOE/CE/30701—T2) Design and construction of the SMUDPV1 1-MW photovoltaic power plant. Final report I. Wool, M.R.; Rosen, D.J. (Sacramento Municipal Utility District, CA (USA); Acurex Corp., Mountain View, CA (USA)). Apr 1985. Contract FC03-82CE30701. 80p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85012241.

The Sacramento Municipal Utility District (SMUD), with cofunding from the US Department of Energy (DOE) and the California State Energy Resources Conservation and Development Commission (CEC), designed, procured, installed, and initiated operation of a nominal 1000 kilowatt power generating facility. The facility converts solar energy directly into electricity using flat plate photovoltaic modules which are mounted on modular single-axis tracking structures. The facility is located adjacent to the Rancho Seco Nuclear Generating Station, southeast of Sacramento, California. Design work began in 1982 and the plant began operation in August 1984. Direct current power from the 112 identical tracking structures is converted to 12.5-kV alternating current power by solid state power conditioning equipment. Overall conversion efficiency, sunlight to utility grid power, is between 8 and 10%. The plant is expected to generate 2.6 million kWh annually. The capital cost of the plant was $12.14 million.

30333 (DOE/ET/20624—T8) Airport solar photovoltaic concentrator, Phase III. Project status report No. ASPCP III-8, February 1, 1984-March 31, 1984. (Arizona Public Service Co., Phoenix (USA)). 9 Aug 1984. Contract AC04-80ET20624. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85006777.

The objectives of the work reported were to operate and evaluate at the Phoenix Sky Harbor International Airport for two years a photovoltaic system consisting of an 80-array subsystem with a nominal rating of 225 peak kilowatts direct current output.

A new set of I-V data was taken on 20 arrays, and it was found that the peak power had decreased 3% from the readings taken when they were new. System operation and maintenance are reported. Progress is reported on isolating problems in the inverter and repairing them. (LEW)

30334 (DOE/ET/20624—T9) **Airport solar photovoltaic concentrator, Phase III. Project status report No. ASPCP III-9, April 1, 1984-May 31, 1984.** (Arizona Public Service Co., Phoenix (USA)). 28 Jan 1985. Contract AC04-80ET20624. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85006775.

The objectives of the work reported were to operate and evaluate at the Phoenix Sky Harbor International Airport for two years a photovoltaic system consisting of an 80-array subsystem with a nominal rating of 225 peak kilowatts direct current output. Operation and maintenance of the power conditioning system and array field are discussed and operating data are given. (LEW)

30335 (DOE/ET/20624—T10) **Airport solar photovoltaic concentrator, Phase III. Project status report No. ASPCP III-10, June 1, 1984-September 30, 1984.** (Arizona Public Service Co., Phoenix (USA)). 30 Jan 1985. Contract AC04-80ET20624. 6p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85006772.

The objective of the work reported was to operate and evaluate at the Phoenix Sky Harbor International Airport for three years a photovoltaic system consisting of an 80-array subsystem with a nominal rating of 225 peak kilowatts direct current output. It was decided to discontinue repairs to the power systems and control inverter, but to replace it. A lightning strike damaged several components in the array control panel. Appropriate surge suppressors were installed as repairs were being made. (LEW)

30336 (NP—5770191, pp 5.1-5.46) **Photovoltaics in the future Danish energy system.** Drud Nielsen, L. (Danmarks Tekniske Hoejskole, Lyngby. Fysisk Lab. 3). Jan 1984. (In Danish). NTIS (US Sales Only), PC A16/MF A01. File Number DE85770191.

EFP-81.

In Technological development and its impact on the future energy system. Appendix 1. Evaluation commissioned by the Danish Ministry of Energy.

The aim of the present account is to elucidate the long-term potentials of photovoltaic power generation in Denmark. A time horizon of fifty years has been adopted, but it is pointed out that actions taken already during the next few decades might influence the practical importance of photovoltaics in the long run. A number of background subjects are briefly treated, such as operating principles and manufacturing methods of photovoltaic solar cells, solar cells moduls, and complete photovoltaic systems. Technological possibilities of efficiency improvements and cost reductions are discussed, and U.S. DOE price and production goals are presented, as well as a European estimate of the future application markets. An account is given of Danish meteorological conditions, with calculation of area requirements and seasonal variations in mind. Also, problems concerning operating strategy, storage systems, exchange of energy with neighbour countries, etc. are briefly mentioned. Finally, it is optimistically concluded that up to 5% of the Danish electrical power consumption in the year 2030 might be supplied from photovoltaic systems, provided that the political will for such a development is at hand.

30337 (PNL—5483) **Photovoltaic industry progress through 1984.** Watts, R.L.; Smith, S.A.; Dirks, J.A. (Pacific Northwest Labs., Richland, WA (USA)). Apr 1985. Contract AC06-76RL01830. 102p. NTIS, PC A06/MF A01; GPO Dep. File Number DE85013029.

The growth of the US photovoltaics (PV) industry over the past decade has been impressive. First designed to provide power for satellites using high-cost production techniques, PV is now the economical choice in many remote terrestrial applications. The remarkable growth of PV in terms of quality of cells and modules, production techniques, and system design, was initiated by a cooperative effort of the US Government and the domestic PV manufacturers. European and Japanese firms entered the PV industry later, but are also growing rapidy. The Europeans continue to supply PV systems for village electrification and water pumping to many Third World countries. The Japanese have been developing the amorphous silicon (A-Si) technology by expanding its use in consumer goods. The world PV industry saw dramatic changes in industry ownership and in the emphasis on developing new and improved technology during 1984. The objective of this report is to present information on the developments of the world PV industry and focuses on developments occurring in 1984. Information is presented on a regional basis (US, Europe, Japan, other) to avoid disclosing company-confidential data. All information was gleaned from several sources, including a review of the technical literature and direct contacts with PV manufacturers. Prior to publishing the regional totals, all numbers were compared with those of other sources. The information contained in this report is prepared for use by the Department of Energy for their use in long-term R and D planning. However, this information should also be of interest by PV manufacturers and to those who may be contemplating entering the PV market. PV shipments for 1984, government supports for PV, and various PV market sectors are discussed.

30338 (SAND—84-2530) **Estimating wind speed as a function of height above ground: an analysis of data obtained at the Southwest Residential Experiment Station, Las Cruces, New Mexico.** Menicucci, D.F.; Hall, I.J. (Sandia National Labs., Albuquerque, NM (USA)). May 1985. Contract AC04-76DP00789. 24p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85013262.

Thermal modelling of photovoltaic arrays requires accurate estimates of wind speed at the level of the arrays. Wind speed data are normally recorded by an anemometer at the 30-foot level. To estimate the relationship between wind speed and height, wind speed data were acquired at various heights in the range of 10 to 30 feet and a nonlinear regression analysis was performed. This analysis shows that, over the range of conditions covered by the present data, the predictive relationship given by the Mechanical Engineer's Handbook is quite accurate; wind velocity can generally be estimated to within +-1.5 mph.

30339 **First-year operational results for the Dallas-Fort Worth Airport linear fresnel lens photovoltaic/photothermal system.** O'Neill, M.J.; Muzzy, D.B. (E-Systems Inc., Dallas, TX). pp 865-876 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

Since June 1978, E-Systems has been developing a combined photovoltaic/photothermal (PVT) power system for the Dallas-Fort Worth (DFW) Airport, under the U.S. Department of Energy's Photovoltaic Application Experiments program. In this paper, a brief description of the system is presented, the performance of the linear Fresnel lens PVT collector module will be provided, the full system performance for the first seven months of continuous operation (September 1982 through March 1983) is presented in detail, a comparison of the measured versus predicted system performance will be shown, and data confirming the reliability and durability of the system are given.

30340 **The ARCO 1 megawatt Photovoltaic Power Plant.** Rhodes, G.W. (BDM Corp. Albuquerque, NM). pp 815 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

The world's largest Photovoltaic Power Plant is in operation on the SCE grid near Hesperia, California. The 1 MW plant designed and constructed by the BDM Corporation, for ARCO Solar Inc., occupies a 20 acre site adjacent to the Southern California Edison (SCE) Lugo substation. The entire design and construction process took 7-1/2 months and was not only on schedule but below budget.

30341 **Economic aspects of photovoltaic power generation for the utility industry: the third-party financing option.** Leonard, S.L.; Munjal, P.K. (Aerospace Corp.). pp 881-892 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

This paper presents the results of an investigation of third-party financing as a method of funding the construction of MW-scale photovoltaic power plants for electric utility service. A description is given of the analysis methodology, which takes into account the provisions of such recently-enacted legislation as the Economic Recovery Tax Act of 1981 and the Tax Equity and Fiscal Responsibility Act of 1982, and the evaluation of a reference case is described. The results are expressed in terms of the "allowable" plant cost, the largest value for the total cost of constructing the plant that will yield the required after-tax return on equity. The sensitivity of the reference-case results to the more critical of the economic assumptions is then explored in detail. For a range of reasonable, if optimistic, values for the economic parameters, photovoltaic power plants costing $4-8/W /sub p/ are shown to be potentially attractive investments for properly structured third-party ventures. The paper also discusses the principal factors that currently inhibit the formation of such ventures.

30342 **First year operation of the Phoenix Sky Harbor solar photovoltaic concentrator project.** Lepley, T.C.; McGuirk, W.J. (Arizona Public Service Co., AZ). pp 877-880 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

This project, one of four concentrator system application experiments sponsored by DOE's PRDA-35 Program, first delivered solar generated electricity in April 1982. The 225 peak kW array field is comprised of 80 Martin Marietta "first generation" passively cooled tracking arrays, which feed a Power Systems and Controls inverter. The ac power output is stepped up to 12.5 kV and fed directly into the APS power grid at the airport site. The Martin concentrator module design is identical, with minor exceptions, to the hardware supplied to the 350 kW Saudi Arabian Village project under the SOLERAS program. Each concentrator uses a Fresnel lens to focus energy (36X) onto a 2.25 in. diameter silicon solar cell. A total of 272 lens-cell combinations are mounted onto a pedestal mounted two-axis tracking array structure. The system was constructed at a cost of approximately $4 million. The initial operating experience has been generally favorable although several problem areas have been identified. The first year's net dc energy production was 295,000 kWh, about 60% of the amount expected from predictive models. A significant factor in the low ouput was the below average amount of direct insolation received at the site.

30343 **The Lovington Square shopping center photovoltaic system.** Wabrek, R.; Risser, V. (New Mexico State Univ., Las Cruces, NM). pp 861-864 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

Since March 1981, a 100 kW flat-plate photovoltaic system has been generating electricity in Lovington, New Mexico. Interconnected with the Lea County Electric Cooperative distribution grid, the energy produced is used by a shopping center located approximately 0.5 mile east of the photovoltaic array. In 1982 the photovoltaic system supplied approximately 8% of the electrical needs of the shopping center. The system availability is more than 99%, with average monthly production of 17,500 kW hours of dc electricity. After conversion to 480 volts ac power, the energy is sold for approximately $750 per month. The system operates automatically and the site is unattended except for a walk-through conducted several times per week. Although the cost of such systems is still high, the Lovington project has demonstrated that photovoltaic systems have many desirable attributes. System description and performance are presented.

30344 **The limits of photovoltaic conversion efficiency- a review.** Stone, J.L. (Solar Energy Research Inst., Golden, CO). pp 847-854 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

If photovoltaics is to gain widespread acceptance and become a viable part of the energy mix for this country, its cost-performance characteristics must be improved beyond where they are today. In particular, this translates into lower cost, higher efficiency, and longer life expectancy. Depending on the energy cost target, windows of opportunity exist which define the performance requirements. This paper examines the value of efficiency as related to making photovoltaics competitive with conventional electricity generating options and reviews the theoretical limits imposed on photovoltaic devices. Several approaches are examined which have potential for greater than 30% conversion efficiency and the current status of this development is reviewed.

30345 **Second-generation linear fresnel lens concentrating photovoltaic collectors.** O'Neill, M.J.; McDanal, A.J.; Waller, R.A. (E-Systems, Inc., Dallas, TX). pp 837-845 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

From 1977 through 1979, E-Systems developed a first-generation linear Fresnel lens concentrating photovoltaic collector system. This system is exemplified by the 27 kw (electric)/140 kw (thermal) Dallas-Fort Worth Airport photovoltaic/photothermal system, which we are currently operating and evaluating under the U.S. Department of Energy's Photovoltaic Application Experiments program. Although this first-generation system is operating at excellent electrical and thermal efficiency levels, its performance and costeffectiveness are far from optimal. From 1980 through 1983, we have been developing a second-generation linear Fresnel lens concentrating photovoltaic collector system, which offers significantly higher performance at substantially reduced cost. The secondgeneration Fresnel photovoltaic concentrator system employs a new collector module design and a new array configuration. The new collector module design allows for either active (forced convection of liquid) cooling or passive (natural convection of air) cooling of the photovoltaic receiver, depending upon application requirements. The new array configuration minimizes expensive field labor by fully assembling the array in the factory. In this paper, the second-generation collector modules is described, the array configuration and operation is discussed, and the performance of both the actively and passively cooled modules are provided.

30346 **Technical aspects of future photovoltaic power systems.** Jones, G.J. (Sandia National Lab, Albuquerque, NM). pp 893-898 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

Future photovoltaic systems will need to be designed to increase acceptance by the potential system owner as well as the host utility. Such systems will maximize their output of high signal quality electricity to the utility through a safe and controlled interconnection, while minimizing the total cost to the owner. These future systems will emphasize the use of modular array field designs and state-of-the-art power conditioning equipment in all applications and tracking collectors wherever practical. These future systems will be designed as a supplier of energy to the utility and only in the residential case will PV be co-located with a load. The major remaining hardware developments necessary to obtain these systems are in the areas of modular residential array design, modular tracking flat-panel field development, and central station power conditioning definition.

1407 Solar Thermal Power Systems

30347 **(DOE/CE—0110) Solar thermal technologies program summary.** (Conservation and Renewable Energy Inquiry and Referral Service, Silver Spring, MD (USA)). May 1985. 3p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85012253.

Report FS 196, 1st edition.

The primary applications being developed in solar thermal technology are the production of electricity and industrial process heat. Additional applications, such as the production of a transportable fuel, are also being studied to determine their feasibility. Two collector concepts are being examined: central receiver and distributed receiver. Some significant achievements are briefly described, as well as program goals and strategies. The research plan for the 1984 fiscal year is also briefly discussed, including a summary of the budget. (LEW)

30348 **(FRNC-TH—1887) Design and construction of a small gas turbine for solar energy conversion. Modeling the system operation in transient conditions.** Leone, J.F. (Institut National des Sciences Appliquees (INSA), 69 - Villeurbanne (France)). 1982. 182p. (In French). NTIS (US Sales Only), PC A09/MF A01. File Number DE85751581.

The aim of this work is the design, the construction and the study of the operation of a small gas turbine for a solar power plant with dispersed collectors. The essential points are the choice of the motor and energy economizer elements as also the experiment leading to the knowledge of the solar power conversion machine possibilities. Advantages and disadvantages with regard to other more classical generating systems are pointed out. A complete modeling allows to define the effects of different parameters on the behavior of the installation as well for nominal operating conditions as for transient conditions. A prediction of the cost price of the electricity produced by such plants is established.

30349 **(PNL—5463) Long-terms goals for solar thermal technology.** Williams, T.A.; Dirks, J.A.; Brown, D.R. (Pacific Northwest Labs., Richland, WA (USA)). May 1985. Contract AC06-76RL01830. 107p. NTIS, PC A06/MF A01; GPO Dep. File Number DE85013032.

This document describes long-term performance and cost goals for three solar thermal technologies. Pacific Northwest Laboratory (PNL) developed these goals in support of the Draft Five Year Research and Development Plan for the National Solar Thermal Technology Program (DOE 1984b). These technology goals are intended to provide targets that, if met, will lead to the widespread use of solar thermal technologies in the marketplace. Goals were developed for three technologies and two applications: central receiver and dish technologies for utility-generated electricity applications, and central receiver, dish, and trough technologies for industrial process heat applications. These technologies and applications were chosen because they are the primary technologies and applications that have been researched by DOE in the past. System goals were developed through analysis of future price projections for energy sources competing with solar thermal in the middle-to-late 1990's time frame. The system goals selected were levelized energy costs of $0.05/kWh for electricity and $9/MBtu for industrial process heat (1984 $). Component goals established to meet system goals were developed based upon projections of solar thermal component performance and cost which could be achieved in the same time frame.

30350 **(SAND—80-8192-Vol.1) Molten Salt Thermal Energy Storage Subsystem Research Experiment. Volume I. Executive summary.** (Martin Marietta Aerospace, Denver, CO (USA)). May 1985. Contract AC04-76DR00789. 46p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85013194.

This report documents work sponsored by the US Department of Energy to design, build, and test a thermal storage subsystem research experiment using molten nitrate salt as the working fluid. The project is part of a continuing program to develop molten salt components and subsystems for central receiver systems. The work was performed by Martin Marietta Aerospace in association with American Technigaz Inc., Arizona Public Service Company, and Stearns-Roger under DOE Contract 20-2988. The design is based on a two tank system, one tank to hold cold (550°F) salt and one to hold hot (1050°F) salt. The cold tank is a conventional design with a carbon steel wall and external insulation. The hot tank employs new technology: it has firebrick insulation internal to a structural shell, with a corrugated liner inside the insulation to contain the salt. The liner is similar to those used in transportation and storage of liquid natural gas. The testing showed that this concept of thermal storage is technically feasible and potentially cost effective. The contract began in November 1980 and testing was completed in August 1982. This report is in two volumes: Volume I is an Executive Summary which gives highlights of the projects. Volume II is the full technical report covering the same information in greater detail.

30351 **(SAND—80-8192-Vol.2) Molten Salt Thermal Energy Storage Subsystem Research Experiment. Volume II. Final technical report.** (Martin Marietta Aerospace, Denver, CO (USA)). May 1985. Contract AC04-76DR00789. 328p. NTIS, PC A15/MF A01. File Number DE85013363.

This report documents work sponsored by the US Department of Energy to design, build, and test a thermal storage subsystem research experiment using molten nitrate salt as the working fluid. The project is part of a continuing program to develop molten salt components and subsystems for central receiver systems. The work was performed by Martin Marietta Aerospace in association with American Technigaz Inc., Arizona Public Service Company, and Stearns-Roger. The design is based on a two tank system, one tank to hold cold (550°F) salt and one to hold hot (1050°F) salt. The cold tank is a conventional design with a carbon steel wall and external insulation. The hot tank employs new technology: it has firebrick insulation internal to a structural shell, with a corrugated liner inside the insulation to contain the salt. The liner is similar to those used in transportation and storage of liquid natural gas. The testing showed that this concept of thermal storage is technically feasible and potentially cost effective. The contract began in November 1980 and testing was completed in August 1982. This report is in two volumes: Volume I is an Executive Summary which gives highlights of the project. Volume II is the full technical report covering the same information in greater detail.

30352 **(SAND—84-8192) Experimental study of free and mixed convective flow of air in a heated cavity.** Humphrey, J.A.C.; Sherman, F.S. (California Univ., Berkeley (USA). Dept. of Mechanical Engineering). Apr 1985. Contract AC04-76DR00789. 292p. NTIS, PC A13/MF A01; 1; GPO Dep. File Number DE85012538.

Free and mixed convection in a strongly-heated rectangular open cavity have been investigated experimentally, to observe the effects of cavity shape and inclination, and of ambient wind, on the velocity and temperature distribution were observed. The long edges of the cavity were horizontal, and parallel to an axis around which the cavity could be rotated. The aperture plane was either vertical ($\alpha = 0^\circ$), or inclined downward at α - 20° or $\alpha = 45^\circ$. The height of the aperture, b, was always 0.0947 m, while the depth of the cavity, a, was set so that a/b = 0.5, 1.0, or 1.46. The bottom and back walls were electrically heated - the top wall was indirectly heated by conduction, radiation and convection. The average wall temperature and the ambient temperature were used to define the dimensionless overheat and Grashof numbers. The Prandtl number was that of air. In the studies of mixed convection, the axis of rotation was horizontal and normal to the ambient wind. The Reynolds number was varied from Re = 120 - 1100 to Re = 2000 - 8740. For both free and mixed convection, wall and gas temperature were measured with thermocouples, and shadowgraph pictures were taken. For pure free convection, three time-averaged velocity components, the corresponding normal Reynolds stress components, and one off-diagonal Reynolds stress component were measured with a two-color laser-Doppler velocimeter. A PDP-11/34 minicomputer controlled the sequence of automatic data acquisition, the statistical data reduction and its storage. Statistical results are presented numerically and graphically for two averaging procedures. The principal quantitative result for free convection is that the rate of convective heat loss across the cavity aperture plane is reduced both by increasing a/b and by increasing α. Qualitative observations are recorded and discussed. The most striking observation was the appearance of a periodic oscillation of frequency 2 to 5.5 Hz.

30353 (SAND—85-8224) **Monograph series No. 2: 10 MWe Solar Thermal Central Receiver Pilot Plant and receiver performance evaluation.** Baker, A.F.; Atwood, D.L. (Sandia National Labs., Livermore, CA (USA)). May 1985. Contract AC04-76DR00789. 54p. NTIS, PC A04/MF A01; GPO Dep. File Number DE85012536.

The plant and receiver performances of the 10 MWe Solar Thermal Central Receiver Pilot Plant located in Barstow, California, are evaluated based on measured and calculated data. An extended data base is used to update the receiver performance reported in March 1983. Full and part load results and trends in receiver performance when operating at varying outlet temperatures and pressures are provided. The plant and receiver performances are compared to design predictions. Data are included for both points in time and average values of performance.

30354 **Solar One project.** DeHaven, N.J. (Southern California Edison, Rosemead, CA). pp E-5-E.5.6 of 1980 Transactions of the American Association of Cost Engineers. Morgantown, WV; American Association of Cost Engineers (1980). (CONF-8007136—).

From 24. annual meeting of the American Association of Cost Engineers; Washington, DC, USA (6 Jul 1980).

This paper describes a US DOE-sponsored project to build a 10 MW central receiver pilot plant at Southern California Edison's Cooling Water Generating Station. The objectives of the pilot plant are to establish the technical feasibility of solar thermal power plants of the central receiver type, to develop sufficient development, production, operating and maintenance cost data to indicate the potential for the economical operation of commercial power plants of similar designs, and to determine the environmental impact of solar thermal central receiver plants. Topics considered include the heliostats, the receiver, the thermal storage system, the turbine generator facility, the master control system, construction management, funding arrangements, cost estimation, the schedule, and the future cost of solar plants. It is concluded that the 10 MW solar thermal central receiver pilot plant will provide hard experience relating to the cost of designing and constructing a solar thermal central receiver electric generating station.

1408 Ocean Energy Systems

REFER ALSO TO CITATION(S) 30367, 30544

30355 (ANL/OTEC-TM—4) **Ocean thermal energy conversion. Annual report, fiscal year 1984.** (Meridian Corp., Falls Church, VA (USA)). Mar 1985. Contract W-31-109-ENG-38. 54p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85012291.

Activities are reported in the area of heat-exchanger development, including designs for aluminum-based heat exchangers, performance/cost models for waterside enhancements, and techniques for low-cost manufacture. Specific objectives of the experimental verification and testing program element include experimentally verifying predicted thermohydraulic performance of heat exchangers and determining the biofouling and corrosion rates of various heat exchanger materials and the effects of heat-exchanger manufacturing processes on seawater corrosion. Progress on system performance/cost modelling is also reported. (LEW)

30356 (DOE/CE—0114) **Ocean energy technology program summary.** (Conservation and Renewable Energy Inquiry and Referral Service, Silver Spring, MD (USA)). May 1985. Contract AC01-83CE30780. 4p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85013102.

FS 197, 1st Edition.

1409 Solar Thermal Utilization

REFER ALSO TO CITATION(S) 30276, 30279, 30285, 30286, 30287, 30287, 30288, 30289, 30290, 30291, 30294, 30347, 30349, 30550, 30557, 30559, 30560, 30565, 31206, 31219, 31220, 31226, 31259, 31265, 31281, 31297, 31298, 31299, 31311, 31313, 31316, 31317, 31318, 31320, 31321, 31355

30357 (BFR-R—30-1983) **Combined solar and surface earth heating for a small group of houses in Perstorp. Results of three years performance monitoring.** Gusten, J.; Baeckberg, H. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1983. 51p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. File Number DE85750849.

The paper discribes a combined surface-soil and solar heating system for a group of five detached houses. The purpose of the work is to study the economy and the dependability of the system. The amount of consumption of electric energy needed for the heating of the houses and the hot water is also examined. The heat-installation system was expected to reduce the energy consumption for heating and hot water by 50 to 60 percent. However, for several reasons the results indicate considerably lower saving. The amount of energy available from the solar and the ground system has been insufficient due to malfunctioning of the heat pumps and in consequence, the elctric battery has been in operation for longer periods than desired. Besides, the losses from the culvert have been larger than calculated.

30358 (CONF-850240—4) **Construction and initial operation of a seasonal solar cooling system.** Harkness, J.B.L. (Argonne National Lab., IL (USA)). Feb 1985. Contract W-31-109-ENG-38. 10p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85009739.

From Alternative energy in the Midwest: research and applications; Schaumburg, IL, USA (21 Feb 1985).

A solar ice-making system based on an Argonne National Laboratory design is considered for home cooling. The water-based storage system, which is a plain concrete tank, was integrated into the foundation of the house. Freon-12 is the working fluid used in the ice-making system. Several modifications were made in the system and brief discussions about these changes are presented. An itemized cost report of the project is included along with drawings for the layout of the system. (BCS)

30359 (CONF-850388—10) **New directions for building thermal storage.** Tomlinson, J.J. (Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 6p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85012779.

From Solar buildings: realities for today - trends for tomorrow; Washington, DC, USA (18 Mar 1985).

The thermal and economic value of incorporating phase change materials (PCMs) as layers in building walls and floors has been determined for a simple, one-room passive solar building through a series of simulations using the analysis code PCMSOL. It was found that the economic value of latent heat storage is strongly affected by the cost of fuel used for supplemental heating, as well as the application (PCM retrofit or PCM incorporated during building construction). Optimal PCM thermophysical property requirements were determined for PCMs located on the floor and walls of a direct gain building and for PCMs used as a Trombe wall, and an allowable storage cost for PCM storage systems was developed. The paper concludes with recommendations concerning PCM research and development for passive solar building heating.

30360 (CONF-8209265—) **Workshop on solar assisted heat pumps with ground coupled storage: proceedings.** Aranovitch, E.; Hardacre, A.G.; Ofverholm, E. (eds.). (Commission of the European Communities, Ispra (Italy). Joint Research Centre). 14 Sep 1982. 569p. NTIS (US Sales Only), PC A24/MF A01. File Number DE85900104.

From Workshop on solar assisted heat pumps with ground coupled storage; Ispra, Italy (14 Sep 1982).

Separate abstracts were prepared for 24 papers in these proceedings. (LEW)

30361 **(DOE/CE—0107) Active solar heating and cooling technology program summary.** (Conservation and Renewable Energy Inquiry and Referral Service, Silver Spring, MD (USA)). Apr 1985. 3p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85012428.

FS 192, 1st Edition.

30362 **(DOE/CE—0109) Passive and hybrid solar technologies program summary.** (Conservation and Renewable Energy Inquiry and Referral Service, Silver Spring, MD (USA)). May 1985. Contract AC01-83CE30780. 3p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85013100.

FS 193, 1st Edition.

30363 **(DOE/CS/34039—T8) Solar Energy Education. Renewable energy activities for earth science .** (New York State Dept. of Education, Albany (USA). Solar Energy Project). 1980. Contract AC01-77CS34039. 77p. NTIS, PC A05/MF A01; GPO Dep. File Number DE85010369.

A teaching manual is provided to aid teachers in introducing renewable energy topics to earth science students. The main emphasis is placed on solar energy. Activities for the student include a study of the greenhouse effect, solar gain for home heating, measuring solar radiation, and the construction of a model solar still to obtain fresh water. Instructions for the construction of apparatus to demonstrate a solar still, the greenhouse effect and measurement of the altitude and azimuth of the sun are included. (BCS)

30364 **(DOE/CS/34039—T10) Solar Energy Education. Industrial arts: student activities. Field test edition.** (New York State Dept. of Education, Albany (USA). Solar Energy Project). Feb 1981. Contract AC01-77CS34039. 138p. Solar Energy Project, c/o Curriculum Services, New York State Education Dept., Albany, NY 12234. File Number TI85010363.

In this teaching manual several activities are presented to introduce students to information on solar energy through classroom instruction. Wind power is also included. Instructions for constructing demonstration models for passive solar systems, photovoltaic cells, solar collectors and water heaters, and a bicycle wheel wind turbine are provided. (BCS)

30365 **(DOE/CS/34039—T11) Solar Energy Education. Home economics: student activities. Field test edition.** (New York State Dept. of Education, Albany (USA). Solar Energy Project). Mar 1981. Contract AC01-77CS34039. 144p. Solar Energy Project, c/o Curriculum Services, New York State Education Dept., Albany, NY 12234. File Number TI85010362.

A view of solar energy from the standpoint of home economics is taken in this book of activities. Students are provided information on solar energy resources while performing these classroom activities. Instructions for the construction of a solar food dryer and a solar cooker are provided. Topics for study include window treatments, clothing, the history of solar energy, vitamins from the sun, and how to choose the correct solar home. (BCS)

30366 **(DOE/CS/34039—T12) Solar Energy Education. Home economics: teacher's guide. Field test edition.** (New York State Dept. of Education, Albany (USA). Solar Energy Project). Jun 1981. Contract AC01-77CS34039. 34p. Solar Energy Project, c/o Curriculum Services, New York State Education Dept., Albany, NY 12234. File Number TI85010361.

An instructional aid is provided for home economics teachers who wish to integrate the subject of solar energy into their classroom activities. This teacher's guide was produced along with the student activities book for home economics by the US Department of Energy Solar Energy Education. A glossary of solar energy terms is included. (BCS)

30367 **(DOE/CS/34039—T13-Pt.3) Solar Energy Education. Solar solutions: Reader, Part III.** (New York State Dept. of Education, Albany (USA). Div. of Curriculum Services). May 1981. Contract AC01-77CS34039. 193p. Solar Energy Project, c/o Curriculum Services, New York State Education Dept., Albany, NY 12234. File Number TI85010360.

A collection of magazine articles which focus on the subject of solar energy is presented in this booklet. This is the third of a four part series of the Solar Energy Reader books. The articles provide brief discussions on the various applications of solar energy including: heat, photovoltaics; wind, hydro, and biomass. A glossary of terms is included. (BCS)

30368 **(DOE/CS/34039—T14) Solar Energy Education. Industrial arts: teacher's guide. Field test edition.** (New York State Dept. of Education, Albany (USA). Solar Energy Project). May 1981. Contract AC01-77CS34039. 34p. Solar Energy Project, c/o Curriculum Services, New York State Education Dept., Albany, NY 12234. File Number TI85010364.

An instructional aid is presented which integrates the subject of solar energy into the classroom study of industrial arts. This guide for teachers was produced in addition to the student activities book for industrial arts by the USDOE Solar Energy Education. A glossary of solar energy terms is included. (BCS)

30369 **(DOE/ET/10737—T1) Demonstration of integrated appropriate technology applied to urban aquatic production farms. Final report.** Tang, A.C. (Waterlife West, Inc., San Diego, CA (USA)). [1985]. Contract FG03-78ET10737. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85012217.

Under this project progress was made towards proving and implementing energy-efficient appropriate technologies in urban aquatic food production. An aquatic food production facility incorporating a solar hatchery and nine outdoor ponds has been completed, and initial tests on the suitability for commercial production of freshwater shrimp, channel catfish, and water chestnut have been performed. The major problem encountered involved obtaining the necessary government permits to build and operate the facility. Future enterprises would benefit tremendously by a prudent streamlining of these permit procedures.

30370 **(DOE/R0/00047—T1) Gearhart fire station passive solar retrofit, City of Gearhart.** (Oregon Appropriate Technology, Inc., Eugene (USA); Rain Umbrella, Inc., Portland, OR (USA)). [1985]. Contract FG06-79R000047. 14p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85013420.

The objective of the retrofit project was to bring the fire station up to current codes and standards for insulation and weather tightness. Because of the unobstructed southern orientation of the four garage doors, it was thought possible to replace the existing solid wood doors with glazed ones and to utilize basic passive solar principles, providing direct gain with the concrete slab floor and the fire vehicle water tanks functioning as thermal mass for heat storage. The project was designed to offer hands-on retrofit experience to those in the community who had an interest in solar technology, but who did not necessarily have a technical background. (LEW)

30371 **(DOE/R8/00448—T1) Farm shop thermo-syphon collector. Final report.** Storhaug, L.W. (Storhaug (Leslie W.), Zahl, ND (USA)). [1985]. Contract FG48-79R800448. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85011337.

The design and construction of a thermo-syphon solar collector are briefly described. The collector works on the principle of natural convection, and it was built to provide supplementary heat for a farm shop. A constant, above freezing temperature is the desired effect of the heater. (BCS)

30372 (DOE/R8/06041—T1) **[Solar heat pump]. Final report.** Hermanson, R. (Viking Engineering, Garretson, SD (USA)). [1985]. Contract FG48-81R806041. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85011323.

Brief discussions of the major components of a solar powered, chemical ground source heat pump are presented. The components discussed are the solar collectors and the chemical heat storage battery. Sodium sulfide is the medium used for heat storage. Catalog information which provides a description of all of the heat pump system is included. (BCS)

30373 (DOE/R9/50014—T1) **Instrumented performance study of a passive solar heated earth sheltered residence.** Yarnell, R.C.; Yarnell, B.K. (Yarnell (Richard C.), Carson City, NV (USA); Yarnell (Barbara K.), Carson City, NV (USA)). Jan 1983. Contract FG03-80R950014. 34p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85012215.

This paper reports the results of a one year effort to gather performance data on an earth sheltered, passive solar house located in Carson City, Nevada. Automatic equipment logged insolation and temperature data for a one (1) year period commencing shortly after completion of construction of the structure and its occupancy by the owners. The use of a recording micrologger reflects an effort to obtain unbiased, factual data on the performance of the house and to reduce the impact of subjective perceptions of the occupants' comfort on the report. Raw data was gathered continuously. A pyranometer measured the amount of whole sky solar radiation. Results were recorded as Btu's per square foot. Thermistors measured temperatures of: (a) outdoor ambient air, (b) indoor living room ambient air, (c) indoor greenhouse ambient air, (d) dining room mass wall, (e) greenhouse mass wall, (f) perimeter earth-sheltered wall, and (g) solar heated DHW storage tank. An event counter recorded user operated insulating adjustments (raising and lowering of insulating of curtains) and auxiliary heating (building or stoking a fire in the wood burning stove).

30374 (DOE/SF/11919—T2) **Determination of properties of zeolite/refrigerant combinations for solar refrigeration systems. Final report.** (Collier Engineering Services, Cave Creek, AZ (USA)). [1985]. Contract AC03-83SF11919. 47p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85012009.

The determination of properties of zeolite/refrigerant combinations of solar refrigeration systems are reviewed in this final report. The US DOE has funded several studies aimed at identifying potential rerigerant/absorption pairs for solar cooling applications. In the case of this report, the absorbent was already chosen (natural zeolite), but criteria of toxicity and heat of vaporization were common among projects. There were three very important criteria studied in this report which were not involved in the other studies. First, a lower evaporator temperature is used in this study than is typical of space cooling applications; second, the effects of molecule size on the system; and third, is the effect of the weight loading differential per unit mass of absorbent.

30375 (FRNC-TH—1883) **Microordinator controlled measuring station for studying the materials of solar system components.** Hamada, H. (Toulouse-3 Univ., 31 (France)). 1982. 155p. (In French). NTIS (US Sales Only), PC A08/MF A01. File Number DE85751589.

All the interfaces making up the data acquisition system and specification of the techniques implemented in its realization are described. The electronic development tool and the development of the computing section (software) are examined. This is then applied to the study of the solar installation for the production of hot water in the restaurant at I.N.S.A. (1500 l/day on average). An analysis is finally developed with a view to optimizing the energy yield of this installation.

30376 (FRNC-TH—1885) **Low temperature techniques for drying sorghum with solar energy: experimentation and micro-computer simulation.** Soponronnarit, S. (Institut National Polytechnique, 31 - Toulouse (France)). 1982. 97p. (In French). NTIS (US Sales Only), PC A05/MF A01. File Number DE85751591.

Sorghum was dried at a low temperature in 200 litre chambers using various techniques which were compared. Technically the most satisfactory method was continuous ventilation using solar energy on other energy source. 3 simple simulation models were selected and their accuracy was tested with a microcomputer using the hourly experimental readings. Results were even more precise if a correction was made in the thin layer drying equation for the drying air velocity. Mean values over 24 hours of readings taken every hour and every hours were also acceptable.

30377 (FRNC-TH—1886) **Keeping experimental track of Bassens solar houses. Thermal and economical aspects.** Taillandier, F. (Institut National des Sciences Appliquees (INSA), 31 - Toulouse (France)). 1982. 13p. (In French). NTIS (US Sales Only), PC A02/MF A01. File Number DE85751588.

Five detached houses, with the same architecture features and 89 sq.m net dwilling surface fitted with either active or passive heating systems or with insulated walls are described. A comparative study of the thermal balances of these houses over a whole heating season is presented. The profitability assessment of the various systems by the calculation of solar extra cost payback through achieved energy saving has been finally established.

30378 (FRNC-TH—1888) **Real site study of a solar passive house with long time heat storage in the ground.** Fabre, J. (Toulouse-3 Univ., 31 (France)). 1982. 129p. (In French). NTIS (US Sales Only), PC A07/MF A01. File Number DE85751587.

A description of the house with passive solar heating which uses an adjoining greenhouse to store heat in the ground is first given. The system was installed at Ramonville St. Agne near Toulouse. Long term thermal balances have been established, thermal comfort has been studied and the various energy supply systems have been evaluated, with proposals for possible improvements. A simulation of storage in the ground using the heat equation in the variable regime and a finite differences method is then presented. Heat transfers by conduction, convection and radiation in the premises for the construction of a model simulating the house have been finally studied.

30379 (FRNC-TH—1902) **Milk pasteurization using solar energy.** Song Hyun Kap. (Ecole Nationale Superieure des Arts et Metiers, 75 - Paris (France)). 1982. 194p. (In French). NTIS (US Sales Only), PC A09/MF A01. File Number DE85751582.

The aim of this work was the design, the construction and testing of a prototype milk pasteurization unit using solar energy with an output of 60 l/h. The present work includes four parts: 1) choice of a milk pasteurization; 2) mounting of the system and testing; 3) analysis of the parabolic through collector efficiency; 4) and modeling of the boiler and cooling circuits.

30380 (LA-UR—85-887) **Vapor phase heat transport concepts.** Neeper, D.A.; Hedstrom, J.C. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 8p. (CONF-850388—4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85009550.

From Solar buildings: realities for today - trends for tomorrow; Washington, DC, USA (18 Mar 1985).

The evolution of the vapor transport concept is briefly discussed. Some of the previous vapor transport designs are presented and include: a vertical collector operating in the percolating mode, a heat pipe, and a self-pumping system. The importance of the heat transfer from the accumulator is considered. Two accumulators are used in conjunction with a solar collector and a condenser in the new vapor system. This new system requires no external cooling and a schematic diagram of the system is provided. (BCS)

30381 (MRI/SOL—0601, pp 255-260) **Alternative energies and combinations of them.** Roth, P. (Universidad Tecnica Federico Santa Maria, Valparaiso, Chile). 1980. NTIS, PC A13/MF A01. File Number DE84017398. (CONF-8004244—).

From 1. SOLARAS workshop on solar cooling; Dhahran, Saudi Arabia (1 Apr 1980).

This overview of the activities of the Mechanical Department of the Santa Maria University, Valparaiso, Chile informs about the main projects of the Solar Energy Laboratory. The Laboratory began its work in the field of solar radiation measurement. Later on, activities in water heating, distillation, cooling, greenhouses, concentrators and wind energy followed. By now, industrial projects and research work in several fields are done. The actual projects deal mainly with combinations of energies. These projects are briefly described.

30382 (MRI/SOL—0601, pp 1-18) **Absorption systems.** Wilbur, P.J. (Colorado State Univ., Fort Collins). 1980. NTIS, PC A13/MF A01. File Number DE84017398. (CONF-8004244—).

From 1. SOLARAS workshop on solar cooling; Dhahran, Saudi Arabia (1 Apr 1980).

The physical principles of absorption cooling system operation are described and a simple analytical model describing the operation of these devices is presented. Heat transfer and pumping power computations are presented for a typical unit. The tendency for the devices to operate at a nearly constant coefficient of performance as the hot storage supply and heat rejection temperatures are varied over moderate ranges is discussed. The tendency of the units to exhibit a linear variation in cooling capacity as the hot storage supply and heat rejection temperatures are varied is also reviewed.

30383 (MRI/SOL—0601, pp 19-32) **Refrigerants for absorption systems.** Merrick, R.H. (Arkla Industries, Evansville, IN). 1980. NTIS, PC A13/MF A01. File Number DE84017398. (CONF-8004244—).

From 1. SOLARAS workshop on solar cooling; Dhahran, Saudi Arabia (1 Apr 1980).

The qualities of refrigerant/absorbent combinations for practical absorption cycles are reviewed to establish an understanding of why only lithium bromide/water and ammonia/water have become commercialized. Lithium bromide/water is identified as the choice for solar cooling with existing absorption technology. The history of solar absorption hardware is covered from the first serious activity in 1973 through current experimental work. The interrelation of the chiller and the solar system is discussed as regards flat plate collectors, high temperature collectors, air cooled heat rejection and storage options. The value of the unitary approach is established and these developments described. Current work to develop an air cooled refrigerant/absorbent combination to fire in the 110° to 115°C range is covered. Development of an evaporatively cooled bromide unit as an alternative to air cooling is discussed.

30384 (MRI/SOL—0601, pp 33-56) **Passive solar cooling.** Sabbagh, J.A. (King Abdulaziz Univ., Jeddah, Saudi Arabia). 1980. NTIS, PC A13/MF A01. File Number DE84017398. (CONF-8004244—).

From 1. SOLARAS workshop on solar cooling; Dhahran, Saudi Arabia (1 Apr 1980).

Passive cooling was applied for generations by builders. However, modern buildings depend completely on mechanical air conditioning. Researchers recently started to look back for passive cooling due to the rising cost of energy. The factors which are involved in passive solar cooling are analyzed. Among those factors are human comfort, its limits, and its interrelation with the conditions of the environment. The methods of reducing buildings heat gain from solar radiation and other sources are discussed. Air movement inside and outside buildings are also discussed. A study of the methods of heat rejection from buildings to the environment and to the soil is discussed. Examples of the methods and devices which were applied in traditional buildings for passive cooling as well as the new concepts and research are given.

30385 (MRI/SOL—0601, pp 57-72) **Solar Rankine cycle system.** Nazer, M. (Univ. of Petroleum and Minerals, Dhahran, Saudi Arabia). 1980. NTIS, PC A13/MF A01. File Number DE84017398. (CONF-8004244—).

From 1. SOLARAS workshop on solar cooling; Dhahran, Saudi Arabia (1 Apr 1980).

Solar energy systems for various energy consuming applications are appearing more and more in the market as the worldwide shortage of conventional energy sources continue. Promising results indicated by recent research activities show that active solar cooling systems will be commercially available in the near future. Two major systems are being considered: Absorption Refrigeration Systems and Rankine Cycle Refrigeration Systems. A description of the Rankine cycle system and principles of operation of the various components is presented. Design and evaluation of several recent development programs are discussed, as well as economics of one of these projects.

30386 (MRI/SOL—0601, pp 73-88) **Assessment of working fluids for Rankine solar cooling systems.** Wali, E. (Univ. of Petroleum and Minerals, Dhahran, Saudi Arabia). 1980. NTIS, PC A13/MF A01. File Number DE84017398. (CONF-8004244—).

From 1. SOLARAS workshop on solar cooling; Dhahran, Saudi Arabia (1 Apr 1980).

The results of an investigation of possible working fluids suitable for the solar, Rankine-cycle, cooling of buildings are presented. The Underwriter's safety requirements, system operating reliability and fluid thermal stability were the primary factors used in the screening process. Although minimum development problems would appear to exist when using steam, a low power level, multistage turbine, having a high degree of superheat, would run at excessive shaft speed resulting in high turbine disc stresses. Among the various organic fluids considered, including those proposed for various prototype developments presently in progress, only the halocarbon compounds R-11, R-113 and R-114 and the fluorinert compounds FC-75 and FC-88 satisfied safety requirements. Their two-phase pressure drops per unit length, mean two-phase heat transfer coefficients and the maximum allowable heat flux were determined for Reynolds numbers of 10000 to 120000 at an average, fully-developed, liquid-phase velocity of 1.22 m/s, and 16.6 mm inside tube diameter. A preliminary assessment based on these results, and those available of static, thermal stability tests together with the values of the vapor pressures in the condensing temperature range and the boiling points, is presented. It indicates that R-113 followed by FC-88 are the most suitable fluids for such application. A final assessment, however, should be based on dynamic thermal stability tests, where boiling, condensing and other stresses are imposed on the fluids.

30387 (MRI/SOL—0601, pp 89-106) **Desiccant and other cooling systems.** Collier, R.K. (Solar Energy Research Institute, Golden, CO). 1980. NTIS, PC A13/MF A01. File Number DE84017398. (CONF-8004244—).

From 1. SOLARAS workshop on solar cooling; Dhahran, Saudi Arabia (1 Apr 1980).

Desiccant cooling systems are those systems which process water vapor in the earth's atmosphere to produce cooling. Since mass transfer occurs between the system and its environment, they are commonly referred to as open-cycle systems. These systems all use a liquid or solid material called a desiccant to remove water vapor from the air. The physical phenomenon by which water is removed is most often absorption on the solid desiccants and absorption in the liquid desiccants. The liquid systems utilize two separate spray chambers for the processes of drying and regeneration. The strong solution (triethylene glycol or lithium chloride and water) is sprayed over cooling coils whose temperature is maintained by a cooling tower. Air to be dried passes through the spray and is dried and cooled. When the desiccant solution absorbs sufficient moisture from the air, it is pumped to another chamber where it is sprayed into an externally heated air stream. This regenerates the solution, which is used again in the drying process. These commercial systems are air driers only and do not produce a significant net cooling. In order to produce cooling, the air being processed must be dried to a greater degree than that desired for human comfort or product protection. This additional dryness is converted to sensible cooling capacity by reinjecting water into the air stream.

30388 (MRI/SOL—0601, pp 107-124) **Application of energy storage for solar cooling.** Sofrata, H. (Riyadh Univ., Saudi Arabia). 1980. NTIS, PC A13/MF A01. File Number DE84017398. (CONF-8004244—).

From 1. SOLARAS workshop on solar cooling; Dhahran, Saudi Arabia (1 Apr 1980).

Storage for solar cooling systems is discussed. Discussions of the various systems used for solar cooling, storage and collection are presented in such a way to facilitate the matching of these basic elements. It is concluded that energy storage is a key aspect of making a collection into a useful cooling system. The storage may be classified according to the loss time dependency. The temperature level has a major role in the characteristics and performance of the storage especially and on the different elements of the cooling system in general. A trial has been done to differentiate between the various types of storage in order to find out the most suitable cooling system components in Saudi Arabia. The findings of this trial is to use either a system composed of refrigerant storage, evacuated tube collector and a Li/Br-water dual absorption system or a battery storage, photovoltaic collector and inverse thermocouple cooling system.

30389 (MRI/SOL—0601, pp 125-167) **Applications of collectors for solar cooling.** Khoshaim, B.H. 1980. NTIS, PC A13/MF A01. File Number DE84017398. (CONF-8004244—).

From 1. SOLARAS workshop on solar cooling; Dhahran, Saudi Arabia (1 Apr 1980).

A collection of information of up-to-date technology for most types of solar collectors, specifically those collectors that are in use for solar heating and cooling systems, is presented. The survey includes a comparison between existing solar collectors and their advantages, features, and efficiency. It is clear that concentrating collectors are the most suitable types of collectors for industrial purposes; nevertheless, the selection of a suitable solar collector should come after the system has been designed and the purpose specified.

30390 (MRI/SOL—0601, pp 168-187) **Simulation studies of solar cooling.** Johnson, G.R. (Colorado State Univ., Ft. Collins). 1980. NTIS, PC A13/MF A01. File Number DE84017398. (CONF-8004244—).

From 1. SOLARAS workshop on solar cooling; Dhahran, Saudi Arabia (1 Apr 1980).

The important features of simulation as applied to solar cooling studies are identified. First, the reasons for simulation are outlined along with the expected results available. Simulations can be used for understanding system relationships, for doing detailed design analysis or for developing simplified design aids. Overall system modeling philosophies and the organization and structure of simulation models are presented along with a discussion of common features of some typical simulation models currently in use or that have been used for simulation studies of cooling systems. The concepts of simulation model verification and validation are also discussed along with sample results found during validation phases for a simulation model. The recommendation here is that unless the requirements for a simulation study cannot be met with an existing model, the TRNSYS simulation model be used. Results for some sample simulation studies are presented. The results are from simulations using the TRNSYS model for Colorado State University Solar Houses I and II utilizing an absorption chilling unit and desiccant cooling, respectively. The studies illustrated provide design information and illustrate the types of results that can be obtained from simulation.

30391 (MRI/SOL—0601, pp 188-226) **Economics of solar cooling.** Anand, D.K.; Morehouse, J.H. (Univ. of Maryland, College Park). 1980. NTIS, PC A13/MF A01. File Number DE84017398. (CONF-8004244—).

From 1. SOLARAS workshop on solar cooling; Dhahran, Saudi Arabia (1 Apr 1980).

The economics of solar cooling is dependent not only upon the usual economic factors such as interest rates, capital investment, inflation, etc., but upon different competing technologies, successful commercialization, as well as the unit cost of energy. In establishing a framework for economic comparison, it is customary to use fundamental concepts of cost estimating and educated guesses as to the state of the economic and technological growth over the period under interest. The economics of solar cooling is discussed by first introducing some basic concepts, applying these to establish a framework for comparison and finally considering several generic systems.

30392 (MRI/SOL—0601, pp 227-244) **Development of solar cooling with air and liquid systems at Colorado State University.** Lof, G.O.G. 1980. NTIS, PC A13/MF A01. File Number DE84017398. (CONF-8004244—).

From 1. SOLARAS workshop on solar cooling; Dhahran, Saudi Arabia (1 Apr 1980).

Several combinations of lithium bromide absorption cooling machines with solar collectors and heat storage units have been developed and evaluated at Colorado State University during the past six years. Three commercial cooling units of two to three-ton refrigeration capacity, three types of flat-plate solar collectors, and three types of evacuated tube collectors have been used in various combinations in two identical residential buildings each with square meters floor area. Detailed reports and technical papers show the performance of these systems in the supply of cooling, heating, and hot water by solar energy. Evacuated tube collectors have provided substantially more cooling than flat-plate types; water chillers have performed better than a direct expansion air cooler; and cold side storage was found unnecessary. Coefficients of performance with solar heat supply at temperatures of 75°C to 90°C were essentially the same as those obtained with fuel, but heat losses from storage tanks, if not minimized, can result in substantial reduction in net cooling delivery. A third structure, identical to the other two, is provided with an all-air solar heating system including solar air heaters and pebble-bed heat storage. The performance of this heating system has been measured and found to be essentially the same as those obtained with flat-plate liquid systems. Cooling of this building by use of the pebble-bed in a day-night heat exchange cycle has also been accomplished.

30393 (MRI/SOL—0601, pp 245-250) **Double effect absorption cooling.** Vliet, G.C. (Univ. of Texas, Austin). 1980. NTIS, PC A13/MF A01. File Number DE84017398. (CONF-8004244—).

From 1. SOLARAS workshop on solar cooling; Dhahran, Saudi Arabia (1 Apr 1980).

The double effect absorption cooling concept represents an alternative as a cooling method at the higher temperatures for which Rankine Cycle cooling systems are being developed. This method has been described and assessed in the literature and commercially available units are available in moderate to large tonnage. The coefficient of performance of available units exceeds one and could be designed for about 1.3; thus the cycle should be seriously considered for future solar, geothermal and waste heat cooling application.

30394 (MRI/SOL—0601, pp 251-254) **Second law analysis of a solid adsorption cycle for a solar refrigerator.** Dupont, M. (Laboratoire sur l'Energie Solaire Centre Universitaire des Antilles-Guyane, Pointe-a-Pitre, Guadeloupe, West Indies). 1980. NTIS, PC A13/MF A01. File Number DE84017398. (CONF-8004244—).

From 1. SOLARAS workshop on solar cooling; Dhahran, Saudi Arabia (1 Apr 1980).

The basic thermodynamic considerations are recalled in order to employ the 13X Zeolite H_2O couple for solar refrigeration. The losses due to irreversibility are analyzed in the concept of energy for a refrigerator composed with a flat plate collector containing the adsorbant and an air cooling condenser without any mobil part.

30395 (MRI/SOL—0601, pp 261-265) **Solar refrigeration activities in the Materials Research Institute.** Brown, R.B. (Universidad Nacional Autonoma de Mexico, Mexico City). 1980. NTIS, PC A13/MF A01. File Number DE84017398. (CONF-8004244—).

From 1. SOLARAS workshop on solar cooling; Dhahran, Saudi Arabia (1 Apr 1980).

The Solar Energy Department of the Materials Research Institute is carrying out research work on solar operated absorption refrigeration systems. A description is made of the systems analyzed and the main problems encountered in the development of the solar refrigerators.

30396 (MRI/SOL—0601, pp 266-272) **Passive cooling systems for humid climates.** Clark, G. (Trinity Univ., San Antonio, TX). 1980. NTIS, PC A13/MF A01. File Number DE84017398. (CONF-8004244—).

From 1. SOLARAS workshop on solar cooling; Dhahran, Saudi Arabia (1 Apr 1980).

Detailed computer simulations imply that passive cooling systems can provide acceptable temperature control without assistance in all American climates. The heat transfer processes operating in passive cooling systems are described. Thermal assumptions and simulation methodologies are noted. The simulation results are presented for residences in various American cities. A roof pond type passive cooling system can provide comfortable temperatures during all hours of a typical summer in all cities. In humid climates, air circulation during the day and ventilation during the night are required in order to achieve comfort. Mechanical dehumidification would require significant energy. Thermal uncertainties are noted and a planned thermal test facility described.

30397 (MRI/SOL—0601, pp 273-277) **Wind effects on buildings and passive cooling by ventilation.** Assassa, G. (King Faisal Univ., Saudi Arabia). 1980. NTIS, PC A13/MF A01. File Number DE84017398. (CONF-8004244—).

From 1. SOLARAS workshop on solar cooling; Dhahran, Saudi Arabia (1 Apr 1980).

In passive cooling of buildings, ventilation is one of the major factors. Natural ventilation can be created if points of different pressures exist at suitable locations. The pressure distribution on a building surface depends upon factors such as form and size of the building, location topography and environmental conditions. To predict the pressure field around a building, the Navier-Stokes equations associated with the necessary initial and boundary conditions must be solved numerically. Methods of finite differences or finite elements are suitable and can be used in this respect. Wind tunnel tests are still required to provide the necessary information to check theoretical and numerical computations against measurements; in particular, when turbulence effects are pronounced.

30398 (NP—5770191, pp 8.1-8.33) **Prospects of solar heating in energy system of the future.** Ellehauge, K.; Oestergaard Jensen, S. (Danmarks Tekniske Hoejskole, Lyngby. Lab. for Varmeisolering). Jan 1984. (In Danish). NTIS (US Sales Only), PC A16/MF A01. File Number DE85770191.

Also published as DTH-LV-R-83-38.

In Technological development and its impact on the future energy system. Appendix 1. Evaluation commissioned by the Danish Ministry of Energy.

Solar heating systems produced in Denmark represent good quality and reasonable effect. They are used as domestic water heaters and usually cover 60-70% of the total hot water demand. A typical water heating system is about 5 m^2 and total effect 750-1100 kWh/ year/m^2 collector, a typical solar water-and-space heater is about 15 m^2 and total effect 450-650 kWh/year/m^2 solar collector. Passive solar heating can be available through suitable building design, solar heat can be stored and used effectively in combination with chemical heat pumps.

30399 **(NP—5900477) Evaluation of performance for a breadbox solar water heater in Iowa.** Getter, R.D. (Iowa Energy Policy Council, Des Moines (USA). Iowa Solar Office). 19 Mar 1985. 20p. NTIS, PC A02/MF A01. File Number DE85900477.

The design and testing of a passive water heater are presented. The design selected was a breadbox type with heat-tape wrapped piping for freeze protection. Monitoring of the water heating system consisted of recording the power consumed by the heat tape and the power used from the storage tank. System performance ranged between 545 and 8090 Btu/day average output and efficiencies ranging fraom 9 to 56%. (BCS)

30400 **(NP—5900978) [Solar energy]. Review of progress, 1983.** Ashram, S.A. (Tata Energy Research Inst., Pondicherry (India). Field Research Unit). 1983. 18p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85900978.

The progress on several projects are briefly reported. Research areas consist of the following: Medium Temperature Liquid Collectors including Solar Ponds, Convective Solar Dryers for Agro-Industrial Products, Rural Energy Needs and Systems, and Retrofitting Passive Heating in SOS Childrens' Village, Leh. A list of publications generated from these research projects is also included.

30401 **(PB—85-157501/XAB) CEC (Commission of the European Communities) modelling group for solar-heating systems and domestic hot water.** II. van Galen, E.; Havinga, J. (Commission of the European Communities, Luxembourg). [1985]. 191p. (EUR—9157-EN). NTIS, PC E08/MF E08.

The objectives of the work carried out are the following: extension and improvement of the initial version of the European detailed model (EMGP) for solar systems. The initial version of this modular program was developed at the Catholic University of Leuven. The validation of the model with the aid of experimental data from the Solar Pilot Test Facilities. The use of the model for system studies. The development of a European simplified method (ESM). The validation of the European simplified method with the aid of the European detailed model.

30402 **(SERI/TP—253-2562) Results of active solar control system testing and the performance effects of sensor degradation.** Farrington, R.B. (Solar Energy Research Inst., Golden, CO (USA)). Mar 1985. Contract AC02-83CH10093. 19p. (CONF-850606—8). NTIS, PC A02/MF A01. File Number DE85002945.

From American Society of Heating, Refrigerating and Air-Conditioning Engineers' semiannual meeting; Honolulu, HI, USA (23 Jun 1985).

The Solar Energy Research Institute has been involved in testing control systems, including thermistors, switches, RTDs, integrated circuit sensors, and controllers, since 1981. The results show serious reliability problems with control systems. Sensors degraded or failed from exposure to high temperature, and controllers did not meet specifications. The effect of sensor degradation on annual performance has been quantified for a particular system configuration in four different locations; as much as 50% of the collected energy can be lost, and the auxiliary energy requirements can increase by 250%. Test results of three prototype control systems for solar space heating are also briefly discussed.

30403 **Application of transparent enclosure theory to solar energy absorption by cylindrical tubes in sunspaces.** Mc Cabe, M.E.; Van Migom, M. (Building Equipment Division, Center for Building Technology, National Bureau of Standards, Gaithersburg, MD). *Journal of Solar Energy Engineering;* **107**: No. 1, 5-9(Feb 1985).

A general matrix formulation for beam and diffuse radiative solar transfer is presented for an enclosure containing partially transparent walls. The general theory is used to study the absorption of radiatn solar energy in a building sunspace having a south-facing window and a row of opaque vertical cylindrical-tube solar absorbers. A two-dimensional model is formulated for the sunspace in which a typical cylindrical absorber tube is subdivided into a number of uniform elements and the window and sunspace surfaces are each represented as single elements. The matrix expressions are evaluated for incident solar flux conditions typical for a south vertical window on a clear winter day. The results are presented as dimensionless ratios of absorbed-to-incident solar flux as a function of the tube spacing to radius ratio. The spatial distribution of absorbed solar flux is presented at discrete time interals for the cylindrical tube. Space and time-averaged values of absorbed solar flux are also presented for the cylinder, the window, and the room. The potential application of these results for thermal modeling in passive solar applications is discussed.

30404 **Consumer retrofit responses.** McKown, C.; Felter, P.E. (Texas Tech Univ., Lubbock, TX). pp 479-482 of Progress in Passive Solar Energy System. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1985). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

Energy costs continue to climb. Most consumers cannot afford to purchase a new energy efficient home; therefore, retrofit becomes an important part of energy conservation. A survey of the Unit neighborhood in Lubbock, Texas revealed that consumers are concerned about energy, were not knowledgeable of passive solar alternatives and that all would consider some form of retrofit. Most consumers indicated that a fifty percent or less reduction in energy costs would be acceptable for them to consider a retrofit. The majority of those surveyed had not visited a passive solar dwelling. This points to the need for models, open houses and ongoing educational activities.

30405 **A design procedure to size windows for naturally ventilated rooms.** Chandra, S. (Florida Solar Energy Center, Cape Canaveral, FL). pp 105-110 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

A step-by-step procedure for sizing inlet and outlet window areas for naturally ventilated rooms is presented. The procedure sizes windows to obtain a desired airflow (cfm) in cross-ventilated rooms for a given wind speed and direction. It accounts for the effects of architectural projections, neighboring buildings, terrain type and insect screening. The procedure has been verified against airflow measurements in a full-scale residence.

30406 **Energy strategy selector for small office design.** Holton, J.K.; Pansky, S.H. (Burt Hill Kosar Rittelman Assoc., Washington, DC). pp 413-418 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

A project has been undertaken to develop energy conservation handbooks for the first of several building types. The work is in support of the Battelle Pacific Northwest Laboratories and the U.S. Department of Energy research project on energy conservation in commercial buildings. The Handbook of Energy Strategies for Small Office Design is viewed as a catalyst that will provide sound guidance by a simple method for the design of energy efficient buildings. It is based on the best current knowledge and state-of-the-art research and demonstration work in energy conservation/passive solar. Extensive investigation on base case building character charstiis, utility rate structures and energy strategies underlie the project. Building performance modeling has been carried out with the ESE program (an ASHRAE TC 4.7 based program) with comparison runs on DOE 2.1b.

30407 **Passive solar cooling systems concepts for small office buildings.** Kantrowitz, M.; Hart, G.K.; Whiddon, W.I. (Min Kantrowitz & Assoc., Albuquerque, NM). pp 419-424 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

This paper summarizes the efforts of a small group of building design professionals and energy analysis experts to develop passive solar cooling concepts including first cost estimates for small office buildings. Although estimated annual energy savings from passive cooling technologies range from modest (5-10% savings), the first cost of these to 40% savings), the first costs of these systems appears to be low (from 0 to 8% over comparable buildings). If these preliminary estimates are borne out in real world applications, simple paybacks from 0 to 5 or 10 years could make passive cooling an attractive energy saving design alternative.

30408 **Occupant effects and interactions in passive solar commercial buildings: Preliminary findings from the US DOE passive solar commercial buildings program.** Kantrowitz, M. (Min Kantrowitz and Assoc. Inc., Albuquerque, NM). pp 433-438 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

While some data on the substantial impact of occupancy factors on energy use in residential buildings exist, these effects in commercial buildings have not been systematically investigated. This paper presents the approach to examining the relationship between occupants and energy use currently being implemented through the U.S. Department of Energy Passive Solar Commercial Buildings Program. The buildings in this program include airports, schools, commercial retail and office space and a variety of community facilities located across the U.S., from Alaska to Alabama. Preliminary findings related to how occupant behavior influences energy use and how users respond to these passive solar commercial buildings are presented. Although data from the buildings in the program are incomplete, they do point out several important conclusions and relevant issues. Most building users seem to be satisfied with conditions in the buildings-the patterns of the relatively few complaints about comfort reveal cool, sometimes drafty mornings and warm afternoons. Some concern about acoustics has also been expressed.

30409 **The Daylight Solar Vent: Flexible design.** Aalfs, M. (Seattle, WA). pp 193-198 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

This paper presents the Daylight Solar Vent (DSV), a concept by which daylighting, solar heating, and ventilation are provided within one flexible system. The intent is to make use of available solar energy to provide ventilation and illumination as well as space heat. Conservation and super insulated houses requiring less than 8 Btu/ft^{2}DD are, by definition, well designed for the cold season when energy efficiency may be the primary design consideration. However, daylighting and ventilation, design considerations that increase in relative importance during the warmer seasons, are all too often sacrificed in narrowly focused design. The DSV concept provides daylighting, ventilation, and solar heating with the flexibility for building occupants to modify the system as solar fluctuates and seasons change. This system is conceived with the Pacific Northwest in mind, although the concept is applicable to most climates. This system provides daylighting/direct solar heat, isolated gain solar heat, or thermal stack summer ventilation. Three primary moving parts allow the system to be converted from one mode to another. 1. A large thermal shutter controls the amount of daylighting. 2. A thermal damper at the top of the stack, when open, allows the system to ventilate as a thermal stack. 3. With the fan activated, and the damper and shutter closed, the system is an isolated gain solar heating system.

30410 **Designing and evaluating a solar subdivision.** Morse, L.F.; Goldman, S.J. (Association of Bay Area Govts., Berkeley, CA). pp 537-542 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

Production homes in new residential subdivisions can be naturally heated and cooled. Subdivision design guidelines show how to lay out streets, lots, buildings and vegetation to use the sun and the wind. The guidelines, along with simple shadow analysis tools, can be used either as design criteria to lay out a site or as review criteria to assess a development plan.

30411 **Creative interior design for thermal storage walls.** Franta, G.; Hogg, S. (ENSAR Group, Lakewood, CO). pp 519-522 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

The creative interior design for thermal storage walls can dramatically improve a passive building's thermal performance, aesthetic characteristics, and human comfort (thermal and luminous).

Recent examples of unique designs are documented and presented in this paper. Color, texture, natural lighting, form, performance, cost, and comfort factors of the thermal storage walls are described for the various designs.

30412 **Energy efficient community and sub-division design for Tumbler Ridge, British Columbia: Passive solar and other dimensions.** Diamond, L. (Univ. of British Columbia, Vancouver, BC). pp 525-530 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

This paper discusses procedures which offer increased energy efficiency for the new resource community of Tumbler Ridge, B.C. This town will house the personnel associated with the mammoth Northeast B.C. Coal Project, upon which the provincial government has staked a significant portion of its economic future. Cost comparisons for road and service layout, site orientation, passive solar gain and other forms of climatic response are presented along with their implications. These lead to changes in both community layout and configuration. The study offers precedents for similar settlements across Canada as well as the United States, (Project commissioned by Canada Mortgage and Housing Corporation, with cooperation of the B.C. Ministry of Energy, Mines and Petroleum Resources and The District of Tumbler Ridge).

30413 **Effects of daylight on interior woods and wood finishes.** Guerin, D.A. (Miami Univ., Oxford, OH). pp 511-514 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

A review of literature was completed in order to determine the extent of research data available on the effects of daylight on interior woods. It was found that color change and loss of moisture content were the most important contributors to visual or physical wood deterioration. Recommendations are made that will help decrease wood deterioration when exposed to daylight in passive solar interiors.

30414 **Passive solar homes: Owners react to their interior environments.** Zentner, M.A. (Virginia Polytechnic Inst. Blacksburg, VA). pp 492-496 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

Perceptions of owners of the interior environment of 28 passive solar homes (PSH) in Virginia were investigated during spring 1982. Almost half reported changes in room use in their current residence as compared to a previous non-solar home. Some noted they entertained to a greater extent therefore staying at home more frequently than in the past. Thermal comfort during different weather conditions was ascertained. Most subjects found their homes to be fairly comfortable year round. Some were cooler than they preferred in winter and warmer than they desired in summer. None of the respondents described their homes as uncomfortably hot or uncomfortably cold during the four seasons. Almost all subjects were satisfied with the interiors of their dwellings and general enthusiasm was apparent. For the most part furnishings had not been purchased especially for these homes. However, those who did so selected pieces that would be less prone to sunlight degradation. Some owners had not lived in their residences long enough to give conclusive evidence regarding appearance or other changes in their artifacts.

30415 **Radon levels in metropolitan Denver homes.** Morse, J.G. (Morse Associates, Inc., Golden, CO). pp 501-504 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

Radon measurements were made in 30 relatively-new electrically heated houses in the metropolitan Denver area. The sample was selected from a group of 59 in which air leakage measurements had been determined previously. The sample was not intended to be representative of the Denver area. The study had two prime objectives: to evaluate radon/radon-daughter levels in the sample tested; to determine if a correlation exists between radon-derived radioactivity and air leakage. Radon detectors (Track Etch /sup R/ Type B, bare) were placed in basements or crawl spaces, living and bedroom areas of the house sample and radon was monitored during February and March 1982, a time of normally minimum ventilation. Radon daughter standards do not exist for the Denver area. In comparison with those established elsewhere, high levels were found in a small, but not insignificant, percentage of the sample tested. An approximate inverse linear relationship was observed between radon daughter concentrations and air leakage, suggesting that the tighter the home, the greater the opportunity for increased indoor radioactivity.

30416 **The effects of color on human comfort levels, heating and cooling loads, and task performance.** Colbert, R. (Sunstone Solar Associates, Forestville, CA). pp 507-510 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

Human beings have evolved from the light of the sun and will predictably respond to the constituent colors of the sun's light. Recent studies have shown that color frequencies will cause a fluctuation in the heart beat, respiration, and blood pressure. Recent studies have shown that color frequencies will affect a person's physical, emotional and psychological comfort levels. The correct color of an interior decoration has been shown to lower the heating or cooling load of a building, and to increase the speed and accuracy at which work tasks are performed. This experiment will analyze what effects the color of a room will have on the comfort levels of human beings, and the corresponding heating and cooling loads of a building's interior environment.

30417 **The human element-influences on solar design and performance.** Reichelderfer, S. (Inland Empire Solar Energy Assoc., Spokane, WA). pp 487-492 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

This paper discusses the critical human element in the design and performance of passive solar homes. The effect of occupant lifestyle on the performance of the home is explored via the likelihood that the occupant will perform certain design dependent operations. It is found that occupants by and large perform the operations, although not always in a manner that maximizes solar performance. Adequate instructions on how to operate systems and whether or not someone is available to perform them appear to be two critical factors in determining how well the occupant performs the operation. Homeowners in this sample had very positive reactions to their homes and their expectations closely matched reality. Both of these are felt to have positive impacts on performance of operations.

30418 **The other debate of overhead glazing: Safety.** Merkle, D.J. (SunWorks, Portland, OR). pp 497-500 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

This paper examines the recent concern about the actual risk of safety glazings, specifically tempered, laminated and wired glass in overhead applications. This debate has been prompted by several spontaneous failures of skylights in populated areas. The primary questions are: how does overhead glazing fail, what are the failure rates and what are the risks associated with those failures? A brief report of ICBO, CABO and Southern Codes shows wide divergence on this issue. Proposed changes in these codes will reflect the conclusion of this national debate. This paper reports the information which has been compiled by City, State and Regional governments, Manufacturers of Glass and Glazing Systems, Independent Test Laboratories and Professional Designers. The paper's purpose is to inform design professionals better about the potential risks involved with overhead glazing.

30419 **Passive solar energy in Arizona: Homeowners' attitudes and perceptions.** Katz, M.A. (Tempe, AZ). pp 467-470 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

As passive solar energy continues its rapid growth, increasingly diversified information is needed to assess what has been accomplished and in which direction to proceed. Included in this information must be feedback from the homeowner detailing how he is getting along with passive solar. Is he satisfied with his energy savings? Is his carpet fading because of that nice direct gain we've brought in? How did he learn about passive solar design and what postoccupancy information would be helpful? This paper discusses a mail response survey filled out by the owners and residents of 27 passive/hybrid solar homes throughout Arizona. Questions were qualitative in nature and focused on the attitudes and perceptions of the respondent regarding such issues as economics, performance, and satisfaction with their solar homes. While no "hard core" statistical methods were applied or assumed, the conclusions drawn from the compiled results should help solar professionals to gain a better understanding of user's concerns and design with these needs in mind.

30420 **An exploratory study of the relationship between owner attitudes and characteristics of earth-sheltered housing.** Gustafson, A.W.; McKown, C. (Texas Tech Univ., Lubbock, TX). pp 475-478 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

On-site interviews were conducted with 24 respondents living in earth-sheltered homes in Texas during the summer of 1982. The majority of the respondents were married, between the ages of 31 and 50 years, had children living at home, had at least some college, were employed in a professional occupation, lived in rural or open country area and had owned single family housing before buying earth-sheltered housing. Additional information is presented regarding the structure, near environment and energy use of the earth-sheltered home. Generally, owners tended to be upscale in innovations and attitudes toward alternative housing. Statistically significant relationships were found between the attitude scales, demographic variables and earth-sheltered housing variables.

30421 **Behavioral implications of living with passive solar homes.** Case, F.D. (Univ. of Tennessee, Knoxville, TN). pp 455-460 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

Case studies of fourteen households in Michigan and Tennessee are examined for behavioral adjustments to operation and maintenance of passive solar and wood burning homes, as well as space/time displacement of household activities. Possible loss of privacy and increased conflict through use of an "open plan" design are investigated.

30422 **Size preferences and user reactions to direct gain and indirect gain configurations.** McLain, J.H. (Virginia Polytechnic Inst., Blacksburg, VA). pp 461-466 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

A 1/12 scale model was constructed to simulate a residential group living space in order to study user preferences of window size or direct gain/indirect gain configurations. Twenty human subjects were asked their reactions to four configurations of the south walls: direct gain, indirect gain, combination, and partial height. The most preferred configuration was the combination or 44% of wall covered by window. The indirect gain received a negative response. Preferences were strongly related to a user's desire for sunlight and the need for privacy.

30423 **Some reflections on psychological comfort and its application to energy conscious design.** Heerwagen, J.H.; Heerwagen, D.R. (Univ. of Washington, Seattle, WA). pp 439-444 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

A biological basis for human psychological comfort is proposed, and its evolutionary origin is hypothesized in relation to the satisfaction of basic human needs. Environments which support these needs are experienced as pleasurable, attractive, psychologically and physically comfortable and are sought out. Environments which do not meet these needs, or which demand too great a psychological or physical adjustment, are experienced as unpleasant, unattractive, uncomfortable, and often anxiety-producing or stressful. Implications for energy conscious fenestration design are discussed in terms of the impact on view, access to sunlight and daylight, and responses to major lighting sources.

30424 **The impact of occupants on the performance of passive solar commercial buildings.** Kroner, W.M. (Rensselaer Polytechnic Inst., Troy, NY). pp 445-450 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

The Visitors Information Center at Rensselaer Polytechnic Institute, Troy, New York, is a passive solar commercial demonstration project funded in part by the U.S. Department of Energy. The building's energy conscious design features integrate energy conservation, passive heating, cooling, and daylighting techniques with innovative comfort technologies, multiple-path-comfort options, multifunction energy flow controls, and HVAC systems. The building has been designed to be user-friendly and provides the means for individual occupants to meet their personal comfort requirements. The building has been occupied since February 1981, and detailed measurements on the building's performance have been collected for two years. Although the occupants are very satisfied with the comfort provided by the building, the hour-by-hour simulation results on energy consumption, used during the design phase, are significantly lower than realtime measurements. The hour-by-hour simulation uses standard thermostat set-points, infiltration rates, and lighting levels in conjunction with the Albany, NY, weathertapes, yet actual energy consumption is 39% higher than predicted.

30425 **Passive solar homes: Incentives for ownership and satisfaction associated with functional characteristics.** Zentner, M.A. (Virginia Polytechnic Inst., Blackburg, VA). pp 451-454 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

Twenty-eight owners of passive solar homes (PSH) in various areas in Virginia responded to a self-administered questionnaire. The data for this project were gathered during the spring of the 1981-82 academic year. Generally, owners were highly educated, fairly affluent individuals with small families. These persons were characterized as ecology minded, do-it-yourselfers. Incentives for residing in a PSH included saving expenditures on fuel, positive feelings about the design characteristics, conservation of natural resources, and the aspects of natural sunlight and warmth. Most respondents reported having little or no trouble locating well-documented information about solar adaptation to meet specific needs. An overwhelming majority of the participants were satisfied with the general interior, exterior, and overall features of their PSH. These levels of satisfaction may be due in part to the degree of involvement in home functioning that the owners reported. Subjects responded to open-end questions and shared many and varied experiences about their PSH. These are described to a greater extent in the text.

30426 **Monitored heating season performance of the Mount Airy public library building.** Frey, D.J.; Holtz, M.J.; Morgan, J.G.; Vest, J.C. (Architectural Energy Corp., Westminster, CO). pp 391-396 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

Actual energy consumption by end use during the winter months for the passive solar library building in Mount Airy, North Carolina is compared to the predicted values and major differences between these two are explored and explained based on data and interpretation of performance. Key elements are occupant reaction to the building and changes in the operational strategies for the building based on feedback from the data acquisition system.

30427 **The DOE passive solar commercial buildings program: Preliminary results of performance evaluation.** Lutha, R.; Fisher, W.J.; Rockwell, P.G. (US Dept. of Energy, Argonne, IL). pp 397-400 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

The U.S. Department of Energy is conducting performance evaluation of the buildings in the Passive Commercial Buildings Program. The objectives of the effort are: 1) to determine how much auxiliary energy is being saved by these passive solar buildings over non-solar buildings, and 2) to determine whether the buildings function, or are perceived to function, as well as non-solar buildings. Some preliminary results of the evaluation are that the buildings are, in fact, saving significant amounts of energy in comparison to non-solar buildings; that a majority of the occupants are satisfied overall with the buildings; that occupancy of the buildings can be substantially different than what was assumed during design; and that passive buildings require a great deal of communication between designers, vendors, and contractors for successful construction.

30428 **Monitored performance of Patoka nature center: A direct gain building with BEADWALL night insulation in southern Indiana.** Moore, F. (Miami Univ., Oxford, GB). pp 387-390 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

The monitoring and analysis of the passive solar heating performance of Patoka Nature Center is described. The Center is located in southern Indiana and was designed by the author (who is also Principal Investigator for the monitoring project). The building has a floor area of 3200 square feet, is heavily bermed and well insulated. The building features 1390 net square feet of direct gain solar collector. This collector is equipped with BEADWALL /sup tm/ night insulation. Thermal storage is provided by a masonry floor and 40 water-filled fiberglass tubes. During the 1981-82 heating season, the building used 257 million Btu for space heating. This was supplied from: auxiliary heating equipment (28%), electric lighting (22%), other equipment (2%), and solar (48%). The annual solar heating efficiency (solar utilized/solar incident on collector glass) was 21.3%.

30429 **Assessment of passive features in residential buildings.** Wood, R.A.; Purcell, G.G. (JBF Scientific Corp., Wilmington, MA). pp 379-384 of Progress in Passive Solar Energy System. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

The following passive solar options were assessed: selective surface mass walls, highly reflective exterior surfaces, infrared reflecting window film, and triple pane windows. The options were assessed for thermal and economic performance for Casper, Wyoming, and Fresno, California. Each of the options is described in detail. Of the three passive solar options, the infra-red reflecting window film appears to be the most economically attractive for both locations. This is followed by the triple pane windows, the selective surface for mass walls, and then by the highly reflective exterior surfaces.

30430 **The 'Mabathoana House' In Qualing: A transitional modern design in Lesotho.** Klein, G.A. (Associates in Rural Development, Inc., Maseru, Lesotho). pp 899-902 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

This paper concerns the design, construction and performance of a thermal storage wall and direct gain house in the lowlands of Lesotho. Infrastructural self-reliance was integral to the design in that the demand for water has been minimized, and the need for grid-supplied electricity eliminated. Alternative, on-site systems provide for very comfortable living at low personal and societal costs. Coupled with the use of locally available, "modern" building materials, this house represents another step in the transition from existing practice to environmentally wise architecture.

30431 **"Water tubes? not in my living room": Homeowner attitudes towards passive solar aesthetics.** Appleyard, W.L. (Sunstructures Inc., Ann Arbor, MI). pp 483-485 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

Passive solar homes often contain new and different looking products and design features. Many are viewed with skepticism and are often installed on the insistence of the designer; explaining that they are essential to the performance of the passive system. In addition to their appearance, many are expensive. The authors felt it was important to get feedback from the owners as to how they felt about these features, whether or not they were being used to their fullest, how the owners felt about their homes now that they had lived with them a while, and what they might do differently if they were to build again. In order to investigate these attitudes and to get feedback on completed designs a questionnaire was distributed to clients who had lived in their homes for at least one year. Additional information was gathered on post-occupancy interviews and site visits.

30432 **Heating season from the Bonneville Power Administration Class B passive solar monitoring program.** McKinsty, M.; Lambert, L. (Bonneville Power Administration, Portland, OR). pp 211-216 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

Thermal performance monitoring results for the 1982/83 heating season from sixteen passive solar houses located in the Pacific Northwest are presented. Use is made of the SERI Class B monitoring methodology. Design effectiveness implications of the data, and comparison with design tool predictions are discussed. The houses are located in Portland, Oregon, and Spokane, Washington. They were designed under the Bonneville Power Administration's Solar Homebuilders Program.

30433 Instrumentation and data analysis for building energy monitoring. Fowlkes, C.W. (Fowlkes Engineering, Bozeman, MT). pp 217-222 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

This paper relates the result of our efforts, spanning several years, toward the goal of making low cost and meaningful thermal measurements on buildings. Experimental pitfalls are illustrated with examples and suggestions for better experimental procedures are given. A data acquisition system using a powerful portable microcomputer in conjunction with compact data acquisition modules is discussed. This paper also discusses real time data analysis methods that may prove useful for short-term performance monitoring. Results of some data using recursive, digital filtering algorithms are presented. These algorithms when programmed on the computer (which can sense and respond in real-time in the physical world using the data I/O modules) form a system with an order of artificial intelligence. The goal of this intelligent system is to form an Energy Signature for the building. The Energy Signature consists of several equivalent thermal parameters of the building which form an energy signature characterizing the building.

30434 From vernacular to daylighting architecture historical aspects. Gerber, M. (CLEA, Les Perdrigals). pp 881-885 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

Work started in 1976 with the rehabilitation of an ancient building in mediterranean climate. At that time, the main concern was to integrate the passive solar architecture in the socio-cultural context, e.g., Les Perdrigals. Another aspect of the work is designing greenhouses for new buildings or retrofits. In a mountain climate, a two story greenhouse will be presented. The use of sun as natural lighting and energy source is demonstrated in a partly underground single family dwelling. First example of a low cost housing program is described. This project for the new Prefecture in Montpellier focused on extensive utilization of daylighting systems. The approach of this project is presented.

30435 Measured performance of 50 passive solar residences in the US. Swisher, J.N.; Duffy, J.J. (Solar Energy Research Inst. Golden, CO). pp 223-227 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

This paper summarizes the thermal performance of 50 passive solar residences in a variety of U.S. locations. These buildings were monitored as part of the Solar Energy Research Institute (SERI) Residential Class B Passive Solar Performance Monitoring Program. The paper describes the monitoring and performance evaluation methods and presents the overall heating season performance of the buildings in graphical form. We draw some general conclusions from these results and discuss the validity of extrapolating such conclusions to passive solar buildings overall.

30436 The Massachusetts multi-family passive solar program: A comparison of monitoring data to design tool predictions. Lofchie, H.; Duffy, J.; Noble, E. (Massachusetts Executive Office of Energy Resources, Boston, MA). pp 229-234 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

The Massachusetts Executive Office of Energy Resources, (EOER) through its Multi-Family Passive Solar Program, (MFPS) has provided design and technical assistance, and funded construction, for solar heating and conservation measures affecting more than 750 apartments at 30 different sites in the Commonwealth. Four sites from the program are monitored as part of the Solar Energy Research Institute (SERI) Level B Program. This paper describes the simulation and monitoring design for one of the apartments in Braintree, Massachusetts, presents performance data collected during the 1982-83 heating season in graphic and tabular form, compares measurements to predictions, and describes analysis of the data to calibrate computer simulation models used for design.

30437 Performance of passive solar and energy conserving houses in California--Class B monitoring. Mahajan, S.; Newcomb, C.; Shea, M. (California State Univ., Sacramento, CA). pp 235-240 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; America Solar Energy Society Inc. (1983). (CONF-830929—).

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Nine passive solar and two conservation houses in various California climates were monitored for a period of one year starting in July 1981. The two conservation houses were located next to passive solar houses for convenient comparison of performance. The Solar Energy Research Institute (SERI) Class B data collection methodology and instrumentation, modified to meet California needs, were used. This included continuous data collection with data stored hourly on cassette tape and processed daily, weekly and monthly on paper tape. In addition to the continuous data, one time measurements were made on each house to determine the building loss coefficient, infiltration rates and furnace efficiency. The hourly data on cassette tape were transferred to disc and then used to analyze the thermal performance of each house. The solar contributions were obtained subtractively and comfort levels maintained are indicated by monthly plots of extreme, and binned inside and outside temperatures. The overall performance for each house is presented and compared to an equivalent non-solar house. In the two cases where solar and conservation houses are nearby, these performances are also compared.

30438 Development of an inexpensive passive solar simulation technique using small-scale models. Lee, K.S. (Ohio State Univ. Columbus, OH). pp 123-128 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

In order to investigate the thermal simulation of a full-sized passive solar building using scale models, a simplified large test unit (6'x6'x7' inside dimensions) was used as a base line in testing the adequacy of the scaling factors, and several test units of half and quarter-scale were used. Various types of passive solar systems – including direct gain, water wall, thermosiphon air collector systems, moveable insulation and multi-zone were used.

30439 Conservation and solar guidelines. Balcomb, J.D. (Los Alamos National Lab., Los Alamos, NM). pp 117-122 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

Guidelines are given for selecting R-values and infiltration levels and determining the size of the solar collection area for passive solar buildings. The guidelines are based on balancing the incremental cost/benefit of conservation and passive solar strategies. Tables are given for 90 cities in the US and the results are also displayed on maps. An example is included.

30440 Relative contributions of beam, sky, and ground components to diffusely reflected sunlight illuminance in physical models. O'Loughlin, P.; Porter, R. (Inst. of Environmental Studies, Miami Univ., Oxford, OH). pp 143-146 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

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By correctly positioning and tilting a physical model, solar altitudes and azimuths can be simulated. This provides a quantitative tool for measuring the interior illumination performance of a building design which uses diffusely reflected sunlight as it's primary illumination strategy. The tilting of the model, however, exposes the glazing to artificial sky and ground components of different luminances. Since the beam radiation contribution (80.7%) dominates the interior illuminance, only a relatively small and insignificant error is introduced. The tilted physical model is a valid simulation tool for predicting interior illuminance from diffusely reflected sunlight under clear sky conditions.

30441 **California's Point System - expansion and improvement.** Huston, B.; Chisti, I.; Mallette, E.E.; Miller, K.A. pp 573-576 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

The California Energy Commission's Point System is a simplified method to analyze the energy performance of residential buildings. Although the system is an accurate predictor of energy use, several modifications would increase its accuracy and application. This paper presents three such changes and provides examples of resulting point tables for each change.

30442 **Overview of the results of the Residential Conservation Demonstration Program.** Campbell, J.A. (Growing Concepts Inc., Tallahassee, FL). pp 577-581 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

The results of the Residential Conservation Demonstration Program are presented. Over portions of the last two years, 170 homes in Florida have been monitored for electrical energy consumption of various energy conservation devices including passive solar design strategies, radiant heat barriers, and ventilation strategies; solar water heaters, dedicated heat pumps, heat recovery units, and high efficiency air conditioners, heat pumps, ceiling fans, and insulation; and high efficiency refrigerators. The measurements of the performance of these devices were conducted under a range of climate conditions in Florida characterized as hot and humid with sample sizes ranging from 1 to 25. Energy savings, peak demand savings, and cost effectiveness data are presented where available.

30443 **Assessing solar and conservation retrofits in home rehabilitation programs for low and moderate income people.** Conklin, C.L. (City Hall, Ann Arbor, MI). pp 589-594 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

A two year study was conducted by the Ann Arbor Energy Office where five solar/conservation demonstrations were conducted on the homes of low income clients in the city's Community Development Department's Home Rehabilitation Program. This paper summarizes the results of that study.

30444 **The California Triangle.** Steinberg, C. (California Dept. of Housing and Community Development, Inglewood, CA). pp 605-606 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

Public Housing in California faces new choices in achieving energy efficiency. Should housing agencies fund/develop units which are superinsulated and the easiest for construction trades, but are not passive or active designs? Or, will Public Housing agencies take a leadership role and create an atmosphere for architects, developers and builders to grasp the sittuation and produce innovative energy efficient housing?

30445 **Energy education for a major builder.** Andrews, S.; Baccei, B. (Solar Spectra, Denver, CO). pp 609-614 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

This paper presents a summary of an energy conservation and passive solar training program provided during 1982 for one of the largest homebuilders in the Denver area. The interaction between the energy design consultants and the builder staff--both past and ongoing--is described. Cost and predicted performance information for several home designs are summarized. The limited developments achieved through the program to date are reported.

30446 **Common errors in design and construction of passive solar homes: Results of a review of NMSEI technical assistance program.** Selinfreund, M.; Farrer, R. (New Mexico Solar Energy Inst., Las Cruces, NM). pp 615-617 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

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One of the state-funded programs of the New Mexico Solar Energy Institute (NMSEI) at New Mexico State University provides citizens of New Mexico with a limited amount of free technical advice on the design, construction, and operation of solar systems. Requests for assistance are now averaging 40 to 50 per month in the solar thermal field alone. Increased efforts to inform the public (especially home builders) through passive solar workshops and through the news media have increased the number of requests concerning the design and construction of solar homes. Most requests for technical assistance fall into this category. Experience in the technical assistance program has identified common areas in which help is needed and identified common errors made in the design and construction of solar homes. Many of the potential owners and/or builders who contact the institute can be divided into two major categories. The first category consists of those that have little or no knowledge of solar essentials but want to build a solar home. They believe that this solar home must be mechanically equipped with collectors, isolated storage systems, and various fluid handling components. The other category is conversant with solar essentials and elects (for personal, aesthetic, or economic reasons) to build a frame house. People in this group often assume incorrectly that they cannot incorporate an adequate amount of thermal mass for heat storage in a frame house.

30447 **New Mexico Solar Energy Institute workshop survey.** Miller, D.; Chilton, S.; Morrison, J. (New Mexico Solar Energy Inst., New Mexico State Univ., Las Cruces, NM). pp 619-622 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

During the summer and fall of 1982 the New Mexico Solar Energy Institute conducted an extensive survey and analysis of its information and education activities, primarily the solar workshop program. This paper presents an evaluation of the workshop survey methodology, the survey findings, and an assessment of program directions based upon these findings.

30448 **Passive Solar Design guidelines and evaluation criteria for builders.** Balcomb, S.; Conkling, M.; Pyde, S.; Vigil, L. (Passive Solar Associates, Santa Fe, NM). pp 623-627 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

This paper describes the New Mexico Showcase of Solar homes, a 1983 project featuring two model solar villages. Key features of the project are emphasized including the private sector character and marketplace considerations. To assure integrity and quality in solar design, the Showcase Advisory Board set guidelines using a balance of conservation and passive solar and addressing the issue of occupant comfort. The guidelines, based on research and methodology developed at the Los Alamos National Laboratory (LANL), were then used to establish criteria and worksheets for builders seeking entry into the Showcase project. Designs accepted for the Showcase met the criteria and have become examples of the transfer of research to practice. Another significant aspect of the project is that it makes accessible very usable and reliable design information to builders, real estate lenders, mortgage lenders, and homebuyers. The worksheets bring the laboratory into the marketplace.

30449 **Test boxes for comparative and competitive experiments teaching passive solar design.** Moore, F. (Miami Univ., Oxford, OH). pp 629-631 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

Two types of experimental projects were assigned to the author's passive solar course for Miami University students. Students constructed identical foam test boxes. These were used in teams to experimentally compare the performance of various assigned passive solar configurations. Each student, using data monitored collaboratively by the team, independently analyzed the results and presented conclusions. In a separate project, each student designed and constructed a liquid solar collector (active or passive). These were competitively tested and the results presented by each student in a technical paper.

30450 **Solar Architecture in Schools: An innovative community approach.** Leslie, R.P. (Rensselaer Polytechnic Inst., Troy, NY). pp 633-636 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

An Architect-in-Schools program has completed its second year with a unique emphasis on solar architecture under joint funding from the New York Foundation for the Arts and the Schalmont Central School District. The program supported 84 sessions of an architect in residence. Hands on experimentation with solar design parameters culminated with the actual construction of solar greenhouse additions to two schools. These greenhouses were designed by students in grades 4 and 5 and were constructed as workshops involving the entire community. The program not only provided solar architecture as a synthesizing academic exercise for the school children, but also provided community consulting time and lectures on energy conscious design. The establishment of an annual Energy Fair further involved the community.

30451 **Curriculum for the Los Alamos method.** Arenson, M.; Stayton, R. (Sunscope Resources, Santa Cruz, CA). pp 637-639 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

A curriculum for teaching the Los Alamos passive solar analysis method has been developed. The Los Alamos method is a quick and fairly accurate tool for estimating the peromance of a wide variety of passive solar configurations. However, the method as presented in Volumes 2 and 3 of the Passive Solar Design Handbook is not easily accessible to many people. The authors have developed a curriculum for a community college course in solar home design that presents the Los Alamos method in a coherent fashion. The curriculum has been tested and improved over three semesters. The performance of the students proves that the Los Alamos method can be taught to both professionals and novices with limited math background if the presentation is greatly clarified. This paper describes the curriculum and the steps taken to develop it.

30452 **Your solar house thirty-five years later.** Katz, J.S. (MIT, Cambridge, MA). pp 641-646 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

The following study re-examines a 1947 book of passive solar house designs, the results of a project sponsored by a leading U.S. glass company. From interviews with people involved in solar research and energy-conscious design and using computer studies, an analysis of the reasons for the rise and fall of post-war solar design was conducted. It was found that net energy gained from solar proved to be a less significant influence on later developments than the aesthetic qualities for which these houses were also designed.

30453 **A gas-fired heat pipe zone heater for passive solar buildings.** Winn, C.B.; DeWinter, F.; Kirkpatrick, A. (Colorado State Univ., Fort Collins, CO). pp 655-660 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

A heat pipe zone heater for backup heating in passive solar buildings is described. The gas-fired zone heater has lower operating costs than alternative zone heaters. It also has the boiler outside the building envelope and the condenser inside so that combustion products are not generated inside the conditioned space. Energy conserving features of the zone heater include a low thermal capacitance boiler, low flue gas temperature due to the self-regulating effects of the heat pipe, the use of outside combustion air, and elimination of vent penetrations of the heated envelope (only a small diameter, easily sealed transport section of the heat pipe will penetrate the envelope). The use of the zone heater with a passive heating system results in reducing life cycle costs for heating and also affects the Conservation Factor for the various passive system types and locations. The conservation factor gives the optimal combination of energy conservation and passive solar design for a building. The conservation factor is modified in this paper to account for the use of a zone heater in a given zone in an energy conserving passive solar building. Analytic solutions to constrained and global optimizaton problems are also presented.

30454 **Overhead glazing and thermal comfort control.** Hoffman, H.H. (Wm. John Poss & Associates, Aspen, CO). pp 661-664 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

Thermal comfort is uniquely controlled in this well-oriented and insulated mountain home with extensive overhead glazing. The fully automatic system reduces window heat loss and gain by multiple layers of flame-retardent fabric that rolls up into a compact tube assembly. In addition, a vinylcoated fiberglass screen assembly on a separate track provides sun control while maintaining views to the exterior. The overall sloping to vertical system provides for both effective energy control and a pleasing interior environment.

30455 **A passive solar water pump.** Bell, G.C. (Sun King Enterprises Inc., Albuquerque, NM). pp 665-668 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

In the early 1970s a novel pumping apparatus was researched in England that incorporated a liquid piston in a Sterling Cycle heat engine. However, due to the arrangement of the actual pumping mechanism the heat requirements, i.e., the flux density and quality of heat, were only satisfied by an electrical resistance heat source. Even with this restriction, the pump showed great promise for wide application since it was easily constructed. In the latter 1970s the machine came to my attention. Through extensive research and development, a novel pumping mechanism has been constructed that profoundly affects the entire function of the original pumping apparatus. The new machine operated with only one moving part. The major advantage of this latest design is the requirement for low grade thermal input, easily converted from a solar collection system. An input of 250 watts at 60° C (143° F) can now pump one gallon of water in two minutes through a lift head of 2 meters (6.5 ft).

30456 **Retrofit TAP's for thirteen Pennsylvania schools.** Garrett, D.C.; Anderson, A.K.; Summers, L.H. (Comprehensive Design Assoc. Inc., State College, PA). pp 669-672 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

Relatively inexpensive, however commercial quality, retrofits were made to a variety of Pennsylvania schools varying from elementary schools, to high schools, to university facilities. The south, southeast, and southwest facades of each building were treated with a commercial insulated panel system that was designed as a Thermocirculating Air Panel (TAP). The TAP-FLOW computer program was used to estimate the appropriate vents, and collector proportions. A computerized analysis based on Balcomb's Solar Load Ratio was used in order to determine the effectiveness of the TAP. This paper reports on the diverse problems encountered during the design and execution stages of the retrofits. Because of client requirements, each application used different construction and management styles. A variety of reverse circulation damper stops were used with varying degrees of acceptance and success. At the request of the client, certain TAPs were outfitted with internal shading devices that would control the gain. The TAPs have had great acceptance by the users and are presently being used as examples of solar energy heating by the diverse educational institutions. This paper concentrates on the constructional and client acceptance aspects of the large scale TAP installation (over 12,000 square feet of TAPs to date).

30457 **Assessment of the benefits and implications of retrofit options for existing windows in the UK.** Ruyssevelt, P.; Clegg, P. (Polytechnic of Central London, London). pp 673-678 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

The various options available for retrofitting windows are described and their performance simulated in a domestic situation using the thermal simulation model SUNCODE. Predicted energy savings are presented for each treatment and certain combinations of treatments. The performance of each treatment in terms of solar gain versus heat loss, ability to reduce air infiltration and other characteristics is illustrated. Conclusions are drawn as to the most appropriate applications for the various window treatments.

30458 **Wood frame supported thermal mass floors.** Kelly, E.J. (Sun Structures Inc., Ann Arbor, MI). pp 685-687 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

The direct gain passive solar concept employing a mass floor is quite common and easily constructed in slab-on-grade residences. Often, however, certain design decisions or constraints may require an above grade solution to thermal mass floors for optimum solar performance. Above grade, wood frame supported, thermal mass floors, which can be low-cost, low maintenance, and attractive, have been developed in two residences designed and constructed by SUNSTRUCTURES. The finished result is a mass floor with a dark color added to the concrete with a tile pattern of oak strips set in the floor in one house and a dark slate tile finish in the other. Both of these floors will have good passive thermal storage and sound control characteristics. They are relatively simple to build and are amazingly effective when the need arises to utilize them in the upper story of wood framed residences.

30459 **Vapor control in site-build glazing systems.** Phelps, W.E. (Energy Research & Design Assoc., Jackson, WY). pp 689-692 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

Site-built multiple glazing systems as an alternative to movable insulation offer a cost-effective method for enhancing energy performance in cold climates. Combining various glazing materials and especially high transparency films allows increased R-values without unacceptable losses in net energy gain. This approach is very attractive for horticultural greenhouses where movable insulation is not only expensive but difficult to implement over large areas and on overhead surfaces. One obstruction to the development of techniques in this area is the control of vapor migration into the glazing space. This paper discusses the results of an experimental test room constructed to evaluate the performance of five possible solutions to this problem. The approaches tested include the use of wicks, desiccant vent holes, a combination of sealed insulating unit with a storm glazing added, and a control.

30460 **HVAC control in passive/hybrid buildings with remote thermal storage.** Lindsey, L.L.; De Camp, R.L. (Princeton Energy Group, Princeton, NJ). pp 699-704 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

The interaction of "solar" and "auxiliary" resources in passive/hybrid solar commercial buildings calls for special care in the design and selection of mechanical systems controls. The author reports difficulties experienced with HVAC controls for an otherwise highly successful project, and offers observations which may help other designers avoid such problems.

30461 **An integrated approach to building design.** Vasant, V.; Thomas, J. (Coromandel Engineering Co., Madras). pp 721-725 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

A five story building is to be built in the coastal city of Madras (latitude 13°N) which averages 32°C touching 42°C during summer. To tackle this high temperature and moisture load, several passive features are incorporated and a liquid desiccant open cycle is used to comfort condition the building. Experimental data for a one ton system are presented in this paper.

30462 **Evaluation of a solar thermal and daylighting system.** Meckler, M.; Halldane, J.F. (California Solar Technology, Encino, CA). pp 817-822 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

A solar energy system that incorporates solar space and domestic hot water heating with daylighting advantages was constructed by California Solar Technology (CST). The advantages of reduced space and domestic hot water heating loads, coupled with lower interior lighting loads, resulted in culmulative energy savings of more than 45 percent for a single-family residence in the San Fernando Valley, according to tests conducted over a two-year period. More rigorous and detailed photometric analyses are currently being completed on the CST-designed Litetherm System to verify initial results. Information from the photometric tests is dictating parameters for computer simulation programs that are being completed in the following three areas: optical simulation of the Litetherm System, thermal simulation of the system and optical simulation of the CST 1001 Litetherm Collector. This paper outlines the procedures and calculations used to obtain testing thermal performance data under actual operating conditions for the residential Litetherm System. Also described here is the luminance method of photometry developed for deriving field data. Brief descriptions of the computer simulations described above are given at the end of the report.

30463 Raising the "OPEN U" value by passive means. Baer, S. (Zomeworks Corp., Albuquerque, NM). pp 839-842 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

In hot climates where it is cool at night, buildings can be kept comfortable during hot days by storing cool in the building structure. This is a common technique used throughout the world. This paper describes how to analyze this method.

30464 The courtyard: Passive cooling performance and shading variables. Reynolds, J.S.; Blassel, J.F.; Papers, G. (Univ. of Oregon, Eurgene, OR). pp 843-848 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

This study was begun in winter 1981-1982, in which season Colima's temperature and relative humidity daily range matches the hottest summer conditions of the United States Pacific Northwest. Colima's street grid is oriented about 40° west of south. "East" and "South" faces are heavily sun-stressed in winter; "West" and "North" get the strongest summer sun. From an initial casual observation of about 450 courtyards, a matrix was prepared for categorizing. About 80 were selected for a closer look, of which 31 were photographed and measured for plan. A range of residentialcommercial-institutional buildings, economic status of occupants, and courtyard usages was included. Six of the courtyards were then monitored for two days in December. Daylight, air temperature, surface temperature, relative humidity (RH) and mean radiant temperature (MRT) were recorded both in the courtyards and the street outside. Then the building containing the most cool of these six courtyards was monitored on a hot January day, to compare upper floor-lower floor and interior roomcourtyard-street conditions. Part One Conclusions: While the deeper courtyards stayed cool as expected, the more common shallow courtyards seemed much cooler than the measurements indicated, compared to the street.

30465 Total energy considerations for passive solar strategies in desert climates passive solar. Ahmed, S.F.; Jones, N.S.; Oster, J.R.; Sain, A.M. (Burt Hill Kosar Rittelman Assoc., Butler, PA). pp 849-854 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

The use of passive solar features for family housing at an Army Base in the Mojave Desert, California, has been studied. The passive solar features studied are such which reduce the overall energy requirements for the house both in heating and cooling. Design curves are provided which could be used to estimate the energy savings for heating and cooling for various passive solar strategies and for different size of houses in the area.

30466 Wingwalls to improve natural ventilation: full-scale results and design strategies. Chandra, S.; Fairey, P.; Houston, M.; Kerestecioglu, A.A. (Florida Solar Energy Center, Cape Canaveral, FL). pp 855-860 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

Natural ventilation can be used to cool buildings during many months of the overheated season. A significant design problem arises in ventilating rooms which have only one external wall and, therefore, cannot be normally cross ventilated. Architectural projections called "wingwalls" can be used effectively to ventilate these rooms. This paper confirms the benefit of wingwalls from airflow measurements in a full-scale room with and without wingwalls. Alternative design strategies for incorporating wingwall features in residences are also described.

30467 An environmentally responsive residence for south Louisiana. Cazayoux, E.J. (Univ. of Southwestern Louisiana, Lafayette, LA). pp 873-878 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

With a grant from the Louisiana Department of Natural Resources, Assistant Professor Hector Lasala and I researched how to build in south Louisiana to provide maximum comfort with minimum energy use for people with low to middle income FHA type housing. The product of the study was the design of a four foot modular proto-type house built with the help of architecture students from the University of Southwestern Louisiana.

30468 Senior citizen housing project at Roosevelt, NJ. Lee, S.J.; Holland, E.; Kelbaugh, B. (Kelbaugh & Lee Architects, Princeton, NJ). pp 1029-1034 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

The 21 units of Section 8 Farmer's Home senior citizen townhouses is Kelbaugh & Lee's first multi-family housing design to have been built and one of the first examples of low-rise, high density passive solar housing in the Northeast. It was designed in 19801981 and construction completed in summer 1983. Each unit in the project includes: (1) a small attached greenhouse with massive floor and back wall, (2) a small stagnant Trombe wall with selective surface and direct gain clerestory in each of its one or two bedrooms, (3) a small array of five Big-Fin preheaters in each greenhouse, (4) movable insulation on all but the clerestory windows, (5) a 16SF skylight in the living room for daylighting and direct gain and (6) a solar and wind assisted ventilation chimney for natural ventilation in summer. The central community building incorporates an attached greenhouse with an array of 20 Big-Fins for preheating hot water for its washing machines, dishwasher and lavatories. The solar chimney is designed to obviate the need for air conditioning.

30469 Performance of three air envelope residences in Iowa using mass floor storage. Hadley, R.D. (CHANGE, Solar & Environmental Design, Cedar Rapids, IA). pp 1035-1040 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

Since the introduction of "air envelope" structures as a concept in energy conscious design, a continual controversy has evolved questioning nearly every aspect of their construction and performance. This author agrees with the general concept of air envelope structures, but very much disagrees with the concepts of using earth as a storage media, using concrete culverts as a means of natural cooling, using double vapor barriors in the envelope walls. This paper describes the performance of three homes that differ markedly from those that have gained more notoriety, without the problems of moisture condensation, or large temperature swings.

30470 Passive solar performance of a large mixed building complex ST. Enoch Square, Glasgow, Scotland. Maybaum, M.W. (Consentini Associates, New York, NY). pp 1041-1046 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

The objective of this study is to assess the environmental behavior of the St. Enoch Square Development. The architectural concept comprises a glass envelope enclosing a variety of structures, with the objective of attempting to maximize the passive use of the natural environment in order to reduce the demand for auxiliary energy and consumption of fossil fuels. The study consists of a calculation of temperature and humidity for representative spaces within the envelope exposed to both "typical" conditions (95% of the time), and to "design" or extreme conditions (2-5% of the time). From this, requirements for natural or mechanical ventilation, auxiliary heating and cooling have been determined for each typical space, together with requirements for solar control or shading. On this basis annual energy consumption and operating costs have been established for various different approaches to the relationship between the internal structures and the envelope, and have been compared to the likely consumption of a "conventional" building with the same internal contents. Daylighting studies and physical model testing has been carried out on several proposed arrangements for fenestration in the offices to provide an empirical base for daylighting performance estimates and benefits.

30471 **An experimental passive solar performance assessment on an earth-sheltered house.** Goldberg, L.F. (Univ. of Minnesota, St. Paul, MN). pp 801-814 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

A simple mathematical model describing the performance of energy efficient housing is delineated. The experimental energy performance data obtained from a passive solar, earth-sheltered house over a monitoring period in excess of one year is used to investigate the applicability of the model. The water heater energy consumption unavailable for space heating and the data integration period are parametrically varied to determine their effect on the model applicability. Linear regression analyses performed on the data yield an index which is a candidate for a generally applicable energy efficient housing performance label. The passive solar performance of the house is discussed in terms of the effectiveness of the concrete floor slab as a thermal storage medium and the contribution made by the solar input to the overall space heating requirements. It is concluded that the relationship between the variables encompassed by the mathematical model is not linear over their entire range, although the model is experimentally validated in terms of limit checks. Passive solar technology does make a significant contribution to the energy performance of the house supplying as much as 45% on average of the overall space heating requirements during the winter months.

30472 **Automated generation of shape factors for Mean Radiant Temperature measurement.** Moszienski, J.R.; Formwalt, W.A.; Ling, M.D.F.; Steinmann, M.; Summers, L.H.; White, J. (Pennsylvania State Univ., University Park, PA). pp 31-36 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

Thermal radiation is a significant factor affecting thermal comfort in many types of artificial environments, such as passive solar architecture and radiant panel systems in buildings. Mean Radiant Temperature (MRT) is a measurement of this thermal radiant exchange. The term Operative Temperature (OT) combines the effects of both MRT and air temperature to reflect better the human perception of thermal comfort within an environment. This paper discusses the theory and computer program that calculates the MRT of a person standing anywhere within a rectilinear enclosure for a particular period of time. The use of this program can help the designer achieve optimum thermal comfort conditions and reduce initial and operating costs of heating equipment.

30473 **Interactive computers in the energy-conscious design process.** Novitski, B.J. (Univ. of Oregon, Eugene, OR). pp 25-30 of Progress in Passive Solar Energy Systems. Hates, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

This paper describes a microcomputer program that analyzes microclimates around buildings. User input is via a graphics tablet; analysis is computed by the Brown/Novitski method of climate analysis with SOLMET data (1) from the National Oceanic and Atmospheric Administration (NOAA). The program evaluates the microclimates around a user-defined building in terms of the number of hours in the year that various areas are thermally comfortable as a result of the way the sun and wind behave around the building.

30474 **Analysis of validation data sets in the Class A Performance Evaluation Program.** Hunn, B.D. (Los Alamos National Laboratory, Los Alamos, NM). pp 9-14 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

The primary objective of the DOE Passive Solar Class A Performance Evaluation Program is to collect, analyze, and archive detailed test data for the rigorous validation of analysis/design tools used for passive solar research and design. This paper presents results of the analysis and qualification of several one- and two-week data sets taken at three Class A test sites for the purpose of validating envelope and thermal-storageenergy-transfer processes in passive solar analysis/design tools. Analysis of the data sets consists of editing the measured data and comparing these data with simulated performance results using public-domain, passive solar analysis tools and a standard reporting format developed for the Class A program. Comparisons of the measured data with results using the DOE-2 computer program are presented.

30475 **Results from the Pala Passive Solar Project.** Clinton, J.R. (Solar Energy Analysis Lab., San Diego, CA). pp 15-24 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

The Pala Passive Solar Project consists of a set of eight test buildings devoted to side-by-side testing of passive concepts. Each of seven of the buildings tests a major passive solar feature with the eighth building of conventional design. The two room test buildings are fully instrumented and have been in continuous operation since early 1981. Some of the buildings' special features and construction details are presented. Conclusions drawn from the project during both winter and summer are discussed along with some examples of typical data from the project.

30476 **A generalized model for passive solar direct gain.** Givoni, B. (Ben Gurion Univ.). pp 21-25 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

The correlation model for direct gain developed by the Los Alamos Scientific Laboratory group on Passive Solar Systems, was generalized. While maintaining the general form of the predictive equations the new model, the "Predictive Model for Direct Gain" (PMDG) replaces the original Constants, applicable to the different "reference" cases, by functions depending on the thermal properties of the building and/or the components of the solar system. By this transformation the LASL model for direct gain becomes a generalized one. The new model predict the performance of buildings heated by direct gain with any heat capacity, glazing and night insulation as functions of their thermo-physical properties and the climatic conditions.

30477 **Extension of the un-utilizability method for multiple-aperture passive systems.** Pratt, R.G. (Pratt & Johnson Associates, Taos, NM). pp 39-44 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

The utilizability concept has been successfully applied to performance prediction for passive solar buildings. The method has the advantage of including many design variables in the calculations explicitly, rather than as location-dependent correction factors. The utilizability correlations as originally developed apply only to south-facing collector surfaces. By calculating utilizability from an instantaneous solar model which integrates incident radiation in short time intervals, a first order approximation of an equivalent utilizability for surfaces not facing true south is calculated. Where multiple passive solar apertures contribute to solar gains, the sum of the instantaneous solar gains from the apertures is used to define utilizability for the combination. Thus the method, while requiring an instantaneous solar model, allows for the possibly beneficial or detrimental effects of the relative timing of gains from various window configurations. An example calculation is given for a building with south and southeast-facing windows is given to illustrate the methodology and indicate its usefulness.

30478 A new passive solar space heating system design method for the United States. Cowing, T.; Kreider, J.F. (Univ. of Colorado, Boulder, CO). pp 45-50 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

This paper presents a new method for predicting the annual auxiliary space heating requirements of passively heated solar houses in the United States. It features closed-form, analytical expressions for solar system performance that are amenable to use by architects, engineers, or homebuilders with the aid of an inexpensive, programmable calculator. The method is applicable to direct gain, water storage wall, or mass storage (Trombe) wall passive solar heating systems and is general in practice in that it does not restrict the user to a particular "reference" system. It permits the rapid assessment of the performance effects of variations in such system features as south glazing, thermal storage, or movable insulation. Furthermore, the auxiliary energy estimates of the thermal performance model upon which the method is premised have been compared with measured auxiliary energy usage data from owner-occupied, passively heated solar houses. Substantial agreement exists between predicted and measured results for a number of houses over a series of months within the 1981-82 space heating season. While this in no sense constitutes a complete validation of the thermal performance model, it does demonstrate its viability when applied to actual passively heated solar houses.

30479 Annual thermal utility of internal gains. Palmiter, L. (Ecotope, Inc. Seattle, WA). pp 51-56 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

30480 Passive solar design analysis utilizing electronic spreadsheets. Miles, C.R. (Oxnard, CA). pp 57-60 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

This paper presents a method of analyzing passive solar designs using an electronic spreadsheet program such as Visicalc /sup TM/ or Supercalc /sup TM/. A simplified solar load ratio method developed at Los Alamos National Laboratory has been implemented on a spreadsheet program. This method offers several advantages over manual or specialized computer programs: 1. Parametric analysis of conservation and passive solar options is easily implemented because the worksheet is automatically recalculated each time a value is changed. 2. The user does not have to purchase or learn how to use a specialized program; the spreadsheet program that the user has can be used. 3. This method is not dependent upon a specific operating system or type of hardware.

30481 Micropas, an annual hourly heating and cooling building simulation for microcomputers. Nittler, K.B.; Novotny, R.E. (ENERCOMP, Davis, CA). pp 77-82 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

This paper discusses the development, capabilities, and use of a new building design tool named MICROPAS. MICROPAS, initially developed under contract with the State of California Office of Appropiate Technology to document compliance with the new residential building energy standards in California, brings sophisticated annual hourby-hour heating and cooling simulation analysis capabilities for passive solar and conventional buildings to microcomputers. By simulating a reduced number of hours per year and taking advantage of the dedicated use of microcomputers, MICROPAS maintains reasonable computer run-times and accuracy while incorporating the ease of use typical of today's microcomputer software.

30482 Producing solar savings calculations using a CP/M-based electronics spread sheet. McQueen, L.V.; Martin, D.E. (Washburn Univ. of Topeka, Topeka, KS). pp 61-64 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

Proper design of a passively heated (or cooled) structure is a complex thermodynamic problem, involving many variables. Well-documented work by Balcomb, et al, provides the solar community with the solar load ratio (SLR) method for quickly analyzing different options. However, many hand calculations are needed to produce detailed month-by-month results. This paper will discuss a method of producing estimates and graphs of monthly solar savings fractions using a CP/M-based electronic spreadsheet program, and will show how to integrate either program input or output with a word processor or data base program. This work is based on Passive Solar Design Handbook, Volume 2. This approach replaces tedious with rapid calculations, and should enhance communication between solar designers and their clients. The computer "template" created will be provided to ASES for distribution.

30483 A method to adjust heating and cooling load calculations for different altitudes. Ondris, M. (Front Range Solar Group, Bailey, CO). pp 37-39 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

This paper describes a method to adjust the Degree Day factor for a specific site that differs in altitude from the reporting station.

30484 Comparison of vertical high performance glazing to sloped double glazing with movable insulation. Spears, J.W. (Vitro Laboratories, Silver Spring, MD). pp 253-258 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

This paper compares the monitored performance of a passive solar home in Cincinnati, Ohio, before and after modification of the sunspace glazing system. The National Solar Data Network (NSDN) monitored Solargreen I from March 1980 through August 1981. During this period the sunspace consisted of 300 ft^2 of double glass at a 60° tilt with "Window Quilt" movable insulation. The NSDN resumed monitoring of Solargreen I after the sunspace was rebuilt in the fall of 1982 with 300 ft^2 of vertical, commercially available, quad-pane glazing and no movable insulation. The glazing system consists of two layers of 3M Sungain high transmission film suspended between two layers of glass. The glazing system has a manufacturer's specified U value of 0.26 and a transmittance of

0.63. The building, to which the sunspace is attached, was not changed. This paper compares the performance of the sunspace system with 60° sloped double glazing and movable insulation to the sunspace on the same building consisting of vertical quadpane glazing with high transmission film and no movable insulation. Data for the two systems include transmittance of the glazing system, heat loss and net gain of the glazing system measured using a net radiometer and compared to UAΔT calculations, temperature swings in the sunspace, and overall building performance.

30485 **Survey of design tools for Passive and Hybrid Low Energy Buildings.** Rittelman, P.R.; Ahmed, S.F.; Davy, J.E. (Burt Hill Kosar Rittelman Assoc., Butler, PA). pp 93-98 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

A survey of design tools for Passive and Hybrid Low Energy Buildings has been undertaken as part of the International Energy Agency (IEA), Solar Heating and Cooling Program. A total of 164 design tools have been surveyed. The design tools have been categorized in various ways. The need for further design tools development for certain application has been identified.

30486 **The Residential Energy Manual: An example of use and comparison of results to detailed computer simulation.** Derickson, R.G.; Holtz, M.J. (Professional Engineering Services, Fort Collins, CO). pp 99-104 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

This paper discusses the application of the Residential Energy Manual (REM) heating calculation procedure to design problems and compares the REM Method results to BLAST simulations. The background, technical basis and calculation procedure are briefly described. The use of the REM Method is shown on a 1,600 square foot passive solar home located in Denver, Colorado. Comparison is made between the REM Method and the BLAST simulation values.

30487 **QUIKPAS: A microcomputer based tool for passive solar design.** Bryan, H. (Massachusetts Inst. of Technology, Cambridge, MA). pp 83-88 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

Recently a microcomputer version of CALPAS 1 known as MICROPAS has been developed by the State of California. This paper describes an enhanced version of MICROPAS which we are calling QUIKPAS. This program uses the core algorythms of MICROPAS but the input and output sections have been restructured to facilitate user friendliness. The program was developed around a set of full screen input menus, where design parameters can easily be created, stored, replaced or changed to determine the effects of design alternatives. At any time during the input process the designer can ask for help if any entry is not understood; thus, program documentation is available on the screen, not just in a support manual. The program output, like the input, is menu driven so that the designer can select only that part of the output that is of interest. Various output features can be combined (in spreadsheet fashion) to create user defined tabular or graphic output displays. Future developments that will further increase the program's power and usefulness to the designer are also discussed.

30488 **Use of electronic spreadsheets as design tools.** de Camp, R.L.; Hallagan, W.B. (Princeton Energy Group, Princeton, NJ). pp 65-70 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

30489 **New programs for computer aided design.** Chisti, I.; Huston, B.; Mallette, E.E.; Miller, K.A. pp 89-92 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

30490 **Measured versus SLR-predicted performance of a monitored direct gain home.** Tsongas, G.; Gillen, P.; McKinstry, M. (Portland State Univ., Portland, OR). pp 321-326 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

The purpose of this paper is to compare the actual energy usage of an occupied, newly constructed direct gain home with the original Volume II SLR predictions made during the building's design process and post-design Volume III predictions. The latter predictions have been made using the more appropriate correlations with both the original input data as well as data revised on the basis of observations and measurements resulting from five months of a Class B monitoring program. Both the predicted and measured results are presented. The key questions to be answered are: how good were the original predictions, how much better (or worse) are the predictions based upon the newer correlations and improved input data, and how can actual use of the predictive methodology provide better answers? Because detailed monitoring results are available, the sensitivity of the predicted results to a number of key parameters is analyzed and discussed. The parameters examined include: the setpoint temperature, the infiltration rate, the internal gains, and differences between the R-values of design-specified and as-built building components. Based on the results of this comparative study, recommendations are made for appropriate usage of the SLR design methodology, and needs for improvements in the methodology itself are also noted.

30491 **Heating season performance and thermal characteristics of the NCSU solar house.** DeCicco, J.M.; Boyers, A.S.; Eckerlin, H.M. (North Carolina State Univ., Raleigh, NC). pp 327-332 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.S. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

This paper presents an analysis of heating season performance of the North Carolina State University Solar House. A microcomputer based data acquisition system was used for detailed monitoring during four periods in the winter of 1982-1983. Measurements of 52 temperatures and 4 insolation values in and around the structure were recorded for subsequent analysis. Electrical usage was metered separately for lighting and appliances, domestic hot water, and auxiliary heat (heat pump). Manual logs were kept noting building occupancy and the operation of controllable building features. Using this information, experimental estimates were made of the building loss coefficient, balance point temperature, and other thermal parameters. Monthly building energy consumption was broken down into internal gains, auxiliary heat, and solar gains for both 1981-1982 and 1982-1983 heating seasons. Performance was consistent for the two seasons and the results presented here confirm the effectiveness of the house design.

30492 **One time measurement of the infiltration rate and conductive loss coefficient for houses in California--Class B sites.** Mahajan, S.; Morandi, P.; Mort, D.; Newcomb, C.; Shea, M. (California State Univ., Sacramento, CA). pp 241-245 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

In this paper the measurements of infiltration in residential structures using tracer gas (SF_6) and blower door techniques are compared. Careful measurements using both techniques were made in eleven energy conserving and passive solar houses in California.

During all the measurements, the weather conditions were monitored continuously. Using the data from the blower door measurements, the wind induced and stack induced parameters are calculated. These parameters are then used to calculate the infiltration rates for weather conditions under which tracer gas measurements were The agreement of blower door predictions and experimental tracer gas results are quite good. Results suggest that one should use the blower door methodology for infiltration measurements. The latter has the advantage of giving the instantaneous infiltration rates once the wind speed and the temperature difference between inside and outside is known.

30493 **Passive solar/gas fired heating system characterization and development.** Burns, P.; Armstrong, P.; Winn, B. (Colorado State Univ., Fort Collins, CO). pp 3-8 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

An overview of the work presently being performed in the REPEAT facility is presented. The physical characteristics of the building and the instrumentation are described. Some collected data are next presented and discussed. A brief treatment of parameter estimation ensues which concludes the paper with an example calculation.

30494 **Construction and preliminary performance data on two commercial buildings with active charge/passive discharge solar systems.** Polka, R.; Farrer, R. (New Mexico Solar Energy Inst., New Mexico State Univ., Las Cruces, NM). pp 301-305 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

Two commercial buildings recently constructed in Las Cruces, New Mexico, incorporate low-cost active charge/passive discharge solar systems. The metal roofs of the buildings are used as solar collectors on sunny winter days; in each building, warm air from the space beneath the roof is blown through a rock bed underneath the concrete floor. Heat from the rock bed is transferred passively through the floor slab to the space above. In summer, air from the rock bed is circulated under the metal roof at nighttime to provide some cooling for the rock bed and for the building. The construction of the buildings is described. Preliminary performance data are discussed; this indicates that the metal roofs provide a significant amount of heat in winter but that the cooling cycle is not operating efficiently.

30495 **Passive solar and utility load management: Implications for design performance goals and time-of-use utility rates.** Keniston, S.; Ottinger, C.W. (Keniston & Mosher, San Diego, CA). pp 307-310 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

30496 **Class C survey data versus computer predictions: A comparison between field data and simulations.** Mahajan, S.; Hodapp, E.; Jones, M.; Morandi, P.; Mort, D.; Newcomb, C.; Pond, B.; Shea, M. (California State Univ., Sacramento, CA). pp 311-316 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

Following the Solar Energy Research Institute's (SERI) Class C survey strategy sixty-three passive solar houses located throughout California were visited and detailed information collected from the homeowners including architectural plans, management procedures, major energy uses, photographs, and at least one year of utility billing data. Using these data, inputs for DOE 2.1 and CALPAS 3.01 computer codes were prepared, and the predicted monthly energy use was obtained. The energy use predicted by the codes was compared to the energy use estimated from the billing data. As measure of performance the Building Performance Index (BPI) for each house was calculated using the billing data and the simulated performance. Both computer codes do quite well in predicting the BPI calculated from the billing data considering the difficulty of estimating the energy delivered and often having different weather in the two methods.

30497 **Measurement-based calculation of infiltration in passive solar performance evaluation.** Hamilton, B.; Duffy, J.; Persily, A.; Sachs, B. (The Memphremagog Group, Burlington, VT). pp 295-300 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

Low-cost, measurement-based techniques for calculation of infiltration as a variable in passive solar performance evaluation are suggested as an improvement over the use of an assumed constant air-change rate. Results of infiltration measurements and calculations are reported for 70 passive solar homes. Comparisons are made between two infiltration estimation techniques for 41 of these monitored buildings. The 50 Pascal air leakage rate of 67 of these buildings is compared to selected data on the leakage of non-solar buildings.

30498 **Measured total performance of a solar home using concrete masonry.** Howard, B.D. (National Concrete Masonry Assoc., Herndon, VA). pp 283-288 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

The Roberts Home (Sundance I), located in Reston, Virginia, is a 214 square meter (2300 square foot) three level passive-hybrid solar residence using a single glazed, 62 m^2 (663 ft^2) Trombe wall with automated movable insulation and a 9.1 m^2 (98 ft^2) single sloped glazed sunspace. Concrete masonry comprises an inner core thermal mass, including an air-core hybrid storage system. The winter building heat load was met by 52% passive solar heating, 12% auxiliary backup and 36% internal heat generation. The internal gains were high compared to other monitored buildings. The auxiliary heating thermal integrity was a low 17.77 kJ/m^2 / HDD (0.86 Btu/ ft^2/HDD).

30499 **Heat distribution by natural convection.** Balcomb, J.D.; Yamaguchi, K. (Los Alamos National Lab., Los Alamos, NM). pp 289-294 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

Natural convection between spaces in a building can play a major role in energy transfer. Two situations are investigated: convection through a single doorway into a remote room and a convective loop in a two-story house with a south sunspace where a north stairway serves as the return path. A doorway-sizing equation is given for the single-door case. Detailed data are given from the monitoring of airflow in one two-story house, and summary data are given for five others. Observations on the nature of the airflow and design guidelines are presented.

30500 **Performance and evaluation of a passive solar superinsulated residence in the Northeast.** Thornton, R.K. (Tufts Univ., Medford, MA). pp 271-276 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

A large passive solar superinsulated house has been built in Lexington, MA, (42,4°NL, 6100°F days) and energy use has been monitored for the 198283 heating system using a SERI Class B Passive Solar Data Acquisition System. The house was maintained at an approxmate average (and almost constant) temperature of 70°F, no window coverings of any sort were used, and the solar aperture of the house received approximately 52% of possible solation due to shading by leafless deciduous trees during the heating season. Under these conditions, the house used 0.89 Btu $^{\circ}F^{-1}day^{-1}ft^{-2}$ living area of delivered auxiliary heat. The actual indoor-outdoor temperature difference was used in this calculation. Using base 65 degree days for 1982-83 from the Blue Hills weather station the result is 0.76 Btu $^{\circ}F^{-1}day^{-1}ft^{-2}$ living area. If the 672 ft^2 70°F basement is included the numbers become 0.82 and 0.70. At a cost of $ 0.70/therm the cost of the purchased fuel for space heating this large house was just under $100.

30501 **Two years experience: thermal performance and operating data of the first German 2-story greenhouse retrofit in the city of Kiel, West Germany.** Berndt, G.W.P. pp 277-282 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

This paper describes the renovation of a single-family dwelling built in Kiel, West Germany, in 1951. Special consideration will be given to the passive solar planning criteria which are relatively new to West Germany. The paper discusses problems encountered in the planning, in acquiring approval from the proper authorities, and in the construction process itself. Heating energy consumption preceding and following renovation as well as the thermal performance in the "Wintergarten" during different seasons will be shown. The measured results obtained have been evaluated and translated into planning suggestions for current house construction.

30502 **The Hodges residence: Four years of monitoring performance and occupant reactions.** Hodges, L. (Iowa State Univ., Ames, IA). pp 247-252 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

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The Hodges Residence, an award-winning 2200 square foot superinsulated direct gain passive solar home in Ames, Iowa, has been occupied and monitored for four winters and three summers. It has served as Iowa State University's de facto passive solar research home, with particular emphasis on studying the effects of variations in operation. Thermal performance results are given for different seasons, with and without the use of night insulation, using only off-peak heating, with deliberate natural ventilation during wintertime, and so forth. Psychological impacts on the occupants are also described, with emphasis on temperature swings, glare, indoor air quality, and the use of a masonry floor. Reactions of visitors are also reported.

30503 **Transformations: The design process in residential retrofit active hand / passive design.** Lawrence, V.; Katzenbach, C.B. (Sunstone Design, Hopewell, NJ). pp 1047-1052 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

The author's experience as owner, designer, and builder in the architectural and energy renovation of an early 1800s farmstead in Central New Jersey is reported. Innovative passive design concepts were carefully integrated with the traditional features of an old fieldstone farmhouse to achieve an 85% reduction in the nonrenewable energy use. The study documents the processes and quantitative effects of the energy conserving strategies employed, from insulation and caulking to the addition of a two-story "sunspace" which utilizes the stone mass of the structure as an integral heat storage medium. Emphasis is placed upon the integration of the "new" with the "old" and the importance of user/client involvement in the design choices made. In addition to design and details, cost and performance data are presented where appropriate.

30504 **Smith House, Tannersville, New York.** Robinson, S. (New York, NY). pp 1015-1016 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

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At the beginning of the design process, the clients proposed three priorities: (1) a space and use program for a young, growing family, (2) an urge toward energy self-sufficiency using conservation, solar, wood and wind in the most cost-effective applications, (3) a profound sensitivity to the Art of the local home building traditions which include High Victorian, Stick and Shingle and the Arts and Crafts Movement. The project has been in progress for 15 months. Site visits were made in each season and extensive microclimatic data were gathered or recorded. Construction began June 1, 1983.

30505 **The Van Teeckelenburgh Residence.** Zdepski, M.S. (New Jersey Inst. of Techn., Newark, NJ). pp 1009-1014 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

The description and analysis of a passive solar residence with double, southeast and southwest, orientation. The design includes automated sun tracking insulation, supplementary phase change heat storage system, mass sod roof and interior ventilation systems. Testing and computer assisted thermal modeling indicate unique advantages for the dual orientation design.

30506 **The Umbach Residence as a responsible solar design for a cold, cloudy climate.** Black, R.A. (Sunstructures, Inc., Ann Arbor, MI). pp 1005-1008 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

In a time of ever-increasing energy and construction costs for housing, we find that the homes which do get built are either relatively inexpensive or relatively expensive, with less and less in between. Many good attempts are being made to resolve the energy-efficient, low-cost residence. Yet in contrast, the mid-to-high range market moves on with "business as usual" in spite of economic recession, and many, if not most of these types, still exude an obese and wasteful opulence. This paper attempts to show the inroads passive solar is making into responsible and responsive development of these "separatist" single-family detached residences, hopefully giving their owners a "nudge in consciousness" to their role in local and national energy scenarios. The Umbach Residence located in Saginaw, Michigan, (43.3°N, 7,400 heating degree days (1) and less than 50% average annual sunshine) is such a house. Designed for a successful, young and growing family, it encloses 2,800 square feet of living space and employs energy conserving and passive solar features throughout.

30507 **The custom passive solar sunspace: some design alternatives.** Spears, J.W. (Silver Spring, MD). pp 999-1003 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

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During the past few years new housing has become more difficult to afford. Many people are turning to upgrading their existing homes to meet their changing needs. Passive solar additions are a popular way to improve an older home. They provide added living space, bring sunlight into dark interiors, reduce heating costs, and add to the resale value of the house. Passive solar greenhouses also provide growing space for vegetables and house plants and provide a wonderful source of recreation for the home owner. The design of the custom sunspace addition requires trade-offs between performance, architectural integration and the owner's needs. This leads to some very interesting design solutions that bear no resemblance to the "optimum" sunspace design generated by computer simulations.

30508 **Passive solar strategies as a logic for improved architectural design: two prototypes for modular housing.** Reeder, B.C.; Merkezas, C. (ARCHETYPE, Washington, DC). pp 993-998 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

In developing two passive solar modular housing prototypes for mass production, design research was done by ARCHETYPE. This research was directed toward effectively utilizing the strengths of the current modular industry, and developing climatically responsive, economical and beautiful solutions that would expand the market, save energy, and stimulate do-able qualitative change within the modular industry. Herein we present some of the data derived from that research which has been incorporated within our framework for future design.

30509 **Multi-site library design - South Bend branch libraries.** Troyer, L.; Beard, W.; Cartwright, P.; Lawecki, D.; Ponko, B.; Smith, D. (LeRoy Troyer and Assoc., Mishwaka, IN). pp 989-992 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

This report addresses the development of a single energy-frugal branch library design to accommodate four different sites in the city of South Bend, Indiana.

30510 **Solar elements as classical counterpoint: passive solar design and the revitalization of historic buildings.** Reeder, B.C.; Merkezas, C. (ARCHETYPE, Washington, DC). pp 983-988 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

This paper presents how passive solar strategies have been used by ARCHETYPE in the design Logic for the restoration, renovation, and infill of historic buildings. A design process and two representative projects are described. One project involves a large 84 year old detached Georgian style house. The goal of the project was to restore the original classical historic structure, and renovate and add to the building in such a way as to reinforce its Geogian character and proportion, and, at the same time, exploit the excellent solar orientation and improve the energy efficiency of the house. The second project concerns a 10,000 square foot Beaux Arts townhouse built in 1880 and located in the heart of the historic district of Dupont Circle in Washington, DC. Renovation and restoration of this landmark building for use as professional offices provided an opportunity for the incorporation of passive solar strategies that were by-products in the search for increased efficiency in spatial utilization and architectural enhancement. Both projects have been recognized by local and national preservation groups, proving that passive solar strategies can be successfully compatible with this area of design concern.

30511 **A few examples of passive solar architecture in Switzerland.** Stuby, F.C. (ARAS, Begnins). pp 977-982 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

This paper presents a few examples of passive solar architecture in Switzerland as seen through the projects and building experience of the architect and as lived in and felt in the daily life by the "users."

30512 **The "folded plate roof" - a unique problem solver.** Dunning, A.; Sneesby, D. (SOLCON, Inc., Los Alamos, NM). pp 967-969 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

The folded plate roof has been used successfully by designers and builders for three generations. Its unique strength and simplicity of construction are well established. This paper will review two such plans as applied to solar additions and their thermal performance. The design concept allows for the development of large, pleasant interior spaces while providing ideal angles for solar gain at any latitude. It can be built of inexpensive materials (2 x 4s and plywood) and adjusted for broad spans on widely spaced centers as in these passive solar examples. Our construction firm has specialized in solar plans and remodeling for the past five years. During this time we have found that the sun is even more reluctant to negotiate the design than the client. Problem southern obstructions have frequently obliged us to resort to roof apertures for our solar gain. The most effective system we have used is a folded plate roof design. This sawtooth configuration can be angled to optimize winter gain without unreasonable nighttime loss or summer overheating.

30513 **Passive solar houses without furnaces in the high Rockies.** Holloway, D.R. (Boulder, CO). pp 961-966 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

Recently completed buildings in the author's architectural practice have shown convincingly that passive solar architecture in the high Rockies can achieve nearly 100% space heating and summer cooling at conventional building cost. It is now possible to own a home in this region that requires no auxiliary fossil fuel or electrical energy for heating or cooling--no back-up fans or motors. Back-up wood stoves may be necessary to achieve comfort for a small percentage of the time--depending on the user's willingness to dress appropriately. Utilizing a flexible combination of closed-cell Trombe walls, direct-gain fenestration, floor mass, and solarium/solar chimney in a well-insulated open-plan building, we have been able to achieve comfort during all seasons in settings from 6,000 to 10,000 degree-days F. The two projects that follow, the Champion Residence and the Soft House, also gives witness to the author's fondness for the Domus Aurea built in 1st Century Rome.

30514 **A contextual approach to daylighting.** Paul, P.D. (Paul Partnership, New York, NY). pp 955-960 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

Contextual aspects, that is the effect of surrounding landscape and buildings are more important than sky brightness in determining the quality of daylight in interior spaces. By using traditional design techniques that consider context, daylighting becomes a dependent source of natural light for public buildings used during the daytime. This paper focuses on daylighting principles determined from the collective experience of traditional building forms, applying them to a recently completed DOE commercial passive solar demonstration project: Essex Dorsey Senior Center in Essex, Md. Daylighting and cooling are integrally related as both require a shallow high ceiling space and emphasize perimeter.

30515 **The Provo Office Complex.** Wilcox, B.A.; Gumerlock, A. (Berkeley Solar Group, Berkeley, CA). pp 949-953 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

The design concept for the Provo Office Complex in Provo, Utah includes a series of south-facing clerestories for daylighting and passive solar gain in this severe Rocky Mountain climate. An artificial lighting scheme is well-integrated with the strong and successful daylighting scheme. In addition, the design concept includes the integration of the architectural and mechanical components through the use of an AIRFLOOR concrete floor to provide a second return plenum. In conjunction with the return air plenum in the ceiling, a double return system is established where the most thermally beneficial return path can be used, depending on the temperature of the floor, the office space and the outdoor environment. Thus the thermal mass of the floor can be used to improve both the heating and cooling performance of the building.

30516 **Medium density passive solar production housing.** Cohlmeyer, J.C.; Giaccardo, M.A.; Jones, M.A. (Mark Jones Corp. Santa Fe, NM). pp 943-948 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

The authors' previous work in passive solar production housing was reported in the Sixth Passive Solar Conference with a report on a two unit speculative housing development. This paper describes a completed 31 house passive solar housing development in Santa Fe, New Mexico. It reviews three house types heated by Trombe walls, direct gain or underfloor thermosiphon systems. The paper focuses on site planning, microclimate evaluation, solar access, architectural shading elements and natural cooling strategies.

30517 **Suncatcher Monitoring Project: three years of monitoring.** Maeda, B.T. (Earth Integral Inc., Davis, CA). pp 931-936 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

The Suncatcher Monitoring Project has accumulated a wide variety of data on the Nittler/Maeda Suncatcher house located in Davis, California. The Suncatcher is an innovative passive solar house designed by Living Systems of Winters, California. Highlights of the data include a 81.5% solar heating fraction during the full monitoring period from March 1, 1978 to July 1, 1981, a 100% natural cooling fraction for the three and one half summers monitored, and an average 40% increase in solar gain through the clerestory glass due to the Suncatcher design relative to ordinary south facing vertical glass. Due to various problems, the hourly data acquisition system functioned intermittently during the monitoring period, but hourly data were gathered about 35-45% of the time and daily data was 99% complete. The daily data was gathered as both a complement and a supplement to the hourly data from September 1, 1977 to July 1, 1981. The total collected data has allowed a reliable estimate of the Suncatcher house's performance for both solar heating and natural cooling.

30518 **A thermal history of the Kelbaugh House.** Kelbaugh, D. (Kelbaugh & Lee Architects, Princeton, NJ). pp 925-930 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

The Kelbaugh House in Princeton, New Jersey, the first to incorporate a Trombe wall in the U.S.A., has been monitored for annual energy consumption since 1975. Auxiliary space heating, as well as DHW, cooking and electricity consumption have been recorded for eight years. Results are shown in tabular and graphic form and discussed in light of improvements made to the house over the years.

30519 **Building as hearth- The articulation of building mass in Colorado architecture.** Barrett, D. (Sun Flower Architecture, Boulder, CO). pp 921-924 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

Responding to a high altitude environment, Colorado residential architecture is being shaped by intense solar radiation, extreme seasonal temperature swings, potent winter winds and abundant snowfall. The emerging architecture finds form in responding to these forces through the articulation of mass and glass. Out of this expression of architectural mass, a new sense of hearth is evident as building mass is coupled with the sun to provide radiant warmth to the inhabitants.

30520 **Solar passive heating in Greece.** Stambolis, C. (Heliotechnic Ltd., Athens). pp 907-911 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

This paper reviews the state of the art of the solar passive heating field in Greece. Some generally applicable climatological data are first presented and hence the need and suitability of solar passive heating is explained. Examples of climatologically adapted dwellings from the antiquity and from modern vernacular Aegean architecture are discussed. Some modern solar passive applications are presented together with computer calculated estimates of the performance of direct gain and Trombe wall examples. The paper concludes that solar passive heating in Greece is desirable both on economic and architectural grounds.

30521 **Three passive solar architectures in Tokyo.** Kato, Y. (Yoshio Kato Atlier, Tokyo). pp 903-906 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

Japanese traditional architectures have had passive methods for natural energy, and so it is not difficult for the client to agree about passive design in spite of most of the people thinking that the technology will advance in the future. But it may take time to broaden it because the society has seen high energy equipment. Consulting with each client to agree, it is important to find a common advantage.

30522 **Comparison of design tools: Carried out by member countries of the EEC.** Littler, J.G.F. (Polytechnic of Central London, London). pp 895-898 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

Of the main frame and mini computer models examined, ESP and SUNCODE were found most appropriate for the design of passive solar dwellings in Europe. ESP will be developed further within the EEC Passive Solar Programme and SUNCODE within the UK National Programme. Of the small models, SPIEL, LANL III, CASAMO and Methode 5000 were recommended.

30523 **International Energy Agency Task VIII: description and selected results.** Holtz, M.J. (NAHB Research Foundation, Westminster, CO). pp 889-894 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

This paper discusses the background and results achieved to date of an International Energy Agency Solar Heating and Cooling Program Task on Passive and Hybrid Solar Low Energy Buildings. Task objective, approach and participants are presented as well as results from two international surveys on simulation models and design tools. Conventional reference buildings are described representative of typical design and construction practice in each participating country. Climate similarities are compared through a simple graphic technique. Work in progress is briefly discussed.

30524 **Moisture Control in passive buildings in warm humid climates.** Khattar, M.K. (Florida Solar Energy Center, Cape Canaveral, FL). pp 861-866 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

Moisture Control in passive residential buildings in warm, humid climates has been a persistent problem. Tighter construction and use of a vapor barrier in building envelopes have led to the accumulation of internally generated moisture in winter as well as in summer. In winter, infiltration and ventilation are effective in reducing indoor humidity levels. Figures are presented to show how these processes can effectively remove internally generated moisture as a function of outside and desired inside conditions. Mechanical cooling and dehumidification are essential in the design of passive buildings in warm, humid climates. While passive cooling strategies can reduce cooling requirements, they do not reduce the need for dehumidification. Air conditioners, which are commonly used in passive buildings, do not remove enough moisture from the air because they operate for limited periods of time due to the reduced cooling load in passive structures. This results in a high humidity level in these homes. The humidity problem is aggravated when high efficiency air conditioners are combined with passively cooled buildings. Since these air conditioners can cool more efficiently, they operate for an even shorter period of time, thus removing even less moisture from the air. The following analysis presents the average inside conditions in a "typical" and a "passive" Florida home using both a conventional and a high efficiency air conditioner.

30525 **Sunspace performance and design flexibility in three climates.** Lerner, R.A.; Lenchek, T.; Spencer, G. (Northern Sun, Lynnwood, WA). pp 797-800 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

In the struggle to achieve a livable, affordable, and appealing solar architecture, the sunspace stands out as a much maligned and often misunderstood entity. Subjects of costs, materials, size, use, structural integration, and even appropriateness are controversial among practitioners. But most solar designers will agree that sunspace configurations with glazing restricted to the south face, with roof and endwalls insulated, produce the greatest energy benefits for the home to which it is attached. This notion is supported by analytical studies and the common-sense physics of solar collection and abundantly reinforced by the popular solar literature. In fact, this so-called "optimum" design geometry may offer minimal or no net energy benefits to homeowners over more highly glazed configurations, while considerably constraining the design. The conclusion for designers and contractors of sunspace projects is to recommend and implement projects that satisfy their clients' functional and aesthetic needs and desires. Energy savings, at least over a broad range of climates and designs, will not be compromised.

30526 **Comparison of single-zone gas and multi-zone electric heating systems for passive solar homes in the northern United States.** Oster, J.R.; Admed, S.F.; Madariaga, H.A. (Burt Hill Kosar Rittelmann Assoc., Butler, PA). pp 785-790 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

Single zone (gas) and multi-zone (electric) heating systems are compared for five cities in Northern United States. The source energies for heating systems have been compared. The difference between source energies of two heating systems has been found to be proportional to the heating degree days. The comparison of central cooling system and multi-zoned cooling system is also made.

30527 **Total solar: Hybrid photovoltaic, passive-hot-water and illumination fluorescent-concentrator solar-energy system.** Beebe, R. (OUR FUTURE, San Francisco, CA). pp 765-768 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

An inexpensive modular solar-energy system is proposed. The unique feature of this system is that direct as well as diffuse sunlight is collected by non-tracking fluorescent concentrator panels. Light trapped within these panels is reflected out through their edges and into a light-transmitting structure, then "piped" through this structure into buildings or vehicles where it is used for illumination and to generate electricity and heat. Optical joints retain light collimation through the structure, connecting together individual light-guide sections at corners and intersections. Light extraction units can be located anywhere along the structure; at night they are supplied with light by a single electric light source integral to the structure. In this paper the system's component mechanisms are examined, and theoretical system applications and performances are discussed.

30528 **A state of the art thermosiphon system.** Agnew, W.C.; McIntosh, W.C. (Mark Jones Corp., Santa Fe, NM). pp 761-764 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

The Mark Jones Corporation's work in developing air thermosiphon systems in Santa Fe has been previously reported in the Fifth and Sixth Passive conferences. The previous papers traced the development of two generations of thermosiphons, the first using rock storage, the second rock plus block storage. This paper examines the development and construction of a third generation thermosiphon system built into a relatively expensive custom home. It focuses on the simplified construction techniques of a block bed storage system in which no rocks at all are used for heat storage. An innovative damper door is also presented.

30529 **An integrated phase change heating and cooling system for retrofit and new construction.** Darby, R.; Wright, D. (David Wright Associates, Nevada City, CA). pp 755-760 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

This paper discusses the performance characteristics and retrofit potential of a promising new method of utilizing phase change material (PCM) for heating and cooling of structures. A commercially available phase change salt compound with a phase change temperature of 22.8°C (73°F) is used. The PCM is located within the building structure itself (floors and ceilings) and can be either actively or passively charged. Discharge can also be either passive through radiation and natural convection or active by using fan forced airflow. The system is capable of providing summer cooling operation as well as winter heating operation. General performance characteristics are discussed with respect to various methods of integrating the system into building design. Methods of integrating this system into retrofit and new construction is developed along with a discussion of active/passive charging options and passive distribution methods. Design variations and construction details are also presented.

30530 **Energy savings potential for attached sunspaces in different climates.** Ritschard, R.L.; Huang, Y.J. (Lawrence Berkeley Lab., Univ. of California, Berkeley, CA). pp 739-742 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

Sensitivity analyses were performed using a modified DOE 2.1a code to model sunspace options attached to the south side of a one-story ranch house. Simulations were run in 11 representative cities with different climatic conditions for four sunspace configurations. The sunspace was eight feet in width, and either 12 or 24 feet long and was modelled with a glass or an opaque roof. The sunspace results were compared to a base case house without a sunspace but with similar thermal integrities. Parametric results showed that a sunspace operated under the conditions assumed in this study was able to contribute to the heating loads of the house to which it was attached. An appropriately oriented, designed and operated sunspace will heat itself if one tolerates a sunspace usable only during the day. In a few locations, an attached sunspace will also substantially reduce heating loads for the entire house.

30531 **High performance passive solar heating systems with heat pipe energy transfer and latent heat storage.** van Dijk, H.A.L.; de Wit, M.; van Galen, E.; Hensen, J. (Inst. of Applied Physics TNO-TH, Delft). pp 709-714 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

Preliminary results are reported from a current project on the development of a high performance passive solar heating system. Two special components are introduced: a. A heat pipe as a thermal diode tube for the efficient transfer of collected solar heat from the absorber plate to behind an insulation layer. b. A latent heat storage section with high storage capacity at moderate operating temperatures. Additional advantageous characteristics: the maintenance costs are negligible, and the performance is highly insensitive to unadequate control of the system by the inhabitants. A first global design of the system showed significantly higher predicted gains than a conventional storage wall at however still high manufacturing costs, although the costbenefit ratio was already competitive with a similar active solar system. The project will be concluded at the end of 1983, with an optimized design of the system. First optimization exercises and series of measurements on the single components lead to the expectation that the final optimized design will be characterised by significantly reduced manufacturing costs.

30532 **Product update on options for north-facing glazing.** Davids, B.J.; Franta, G.F. (Alpen, Inc., Lakewood, CO). pp 705-708 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

With careful selection of glazing materials, even north-facing windows can become "net gain" surfaces in passive solar design. Several clear insulating glass products are examined and compared on the bases of net annual energy performance and relative cost. The analysis includes standard insulating glass, as well as high performance glazings utilizing low-emissivity coatings, antireflective coatings, and substitute gas fill. Net heating energy flux is calculated for both moderate and severe winter climates, and glazing performance is compared to typical night insulation systems and to an insulated wall.

30533 **Research on solar food drying at the University of California, Santa Cruz.** Archulets, R.; Berkey, J.; Williams, B. (Univ. of California, Santa Cruz, CA). pp 679-683 of Progress in passive solar energy systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

Research at the University of California, Santa Cruz farm has examined small-scale solar cabinet food dryers. Sun drying and direct and indirect solar convection dryers have been monitored for operating temperatures, drying times, and solar insolation. Each dryer has been evaluated with respect to ease and cost of construction, utility, operating temperatures, and quality of their respective dried products. The relative vitamin C content of spinach and cantaloupe before and after drying has been examined to determine the product quality of the tested units.

30534 **Sizing solar energy systems for agricultural applications and predicting seasonal energy applications and predicting seasonal energy utilization.** Hietala, J.S.; Jacobson, L.D.; Janni, K.A.; Johnson, V.J.; Jordan, K.A. (Northern States Power). pp 705-741 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Sociaty Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

A preferred method for sizing energy systems based on economic considerations was developed in this paper. The use of rules of thumb developed for residential applications is not valid because of the underlying assumptions of the air entering the collector and the need to provide sufficient ventilation air for animal wellbeing. The problems of determining a heat balance from field measurements of solar energy available are minor; however, the determination of the amount of purchased energy which can be replaced by solar energy is complex and requires careful evaluation of system leaks, animal heat production, transient storage of heat, and ventilation rates. Experimental evaluation of solar utilization was found nearly impossible and simulation methods were used to obtain ready answers even though verification with field data is needed, particularly for thermostatically controlled ventilation systems. Nevertheless, simulation methods hold the greatest hope for developing agricultural rules of thumb similar to those developed for the residential trade, and developments in this area are encouraged.

30535 **Large passive "breadbox" water heater.** Bolme, B.M.; Norlin, J.A. (Corps of Engineers, Portland District, Portland, OR). pp 777-780 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

30536 **Superinsulated batch heaters for freezing climates.** Bishop, R.C. (Passive Solar Coop, Denver, CO). pp 807-810 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

An innovative batch-type passive solar water heater has been developed in Denver, Colorado, over the past two years by the Passive Solar Co-op. It is designed for year-round use in Denver's 3300°C -day (6000°F -day) climate, and prototypes have performed very well even in sub-freezing winter conditions. The innovations are very simple, consisting of a manufacturing technique incorporating high levels of insulation and a multi-glazed window of thin high transmission solar films to reduce heat losses from the unit without appreciable losses of solar gains.

30537 **Results of monitoring flat-plate, batch, and solar/wood domestic water heaters.** LaVigne, A.B. (Puget Sound Power and Light Co., Bellevue, WA). pp 801-806 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

During the first year of the project, three flat-plate solar water-heating systems, an active site-built, a passive site-built, and an active commercially built system, were monitored. Data controls were the solar systems operated in a nonsolar, electric-only mode, a standard electric water-heating system, and the average single family residence with electrically heated water in the Puget Power service area, predominantly western Washington. During the second year of the project, a batch solar system and a solar/ wood/photovoltaic system were monitored. To help isolate the effects of solar energy from other parameters influencing the amount of electricity used to heat water, measurements were also made on the effects of lifestyle and water-heating system insulation levels.

30538 Performance of integrated passive solar water heaters in U.S. climates. Cummings, J.; Clark, G. (Trinity Univ., San Antonio, TX). pp 791-796 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

Results presented are based on partially validated, hourly simulations of passive solar domestic water heating systems for selected typical years in 10 cities. The simulated system is an integrated (or "breadbox") collector/storage unit plumbed as a preheater for a conventional gas or electric heater. The base case unit was latitude tilted and contained 4 cylindrical tanks plumbed in series within an R16 box. The aperture and projected absorber area were 1.62 m^2, and total tank volume was 145 liters. Water draw was 151 liters/day at 50°C. A variety of design performance sensitivity results are presented. The single-glazed, selective absorber design is recommended. For this design the passive heater delivered 42% to 51% of the annual solar irradiance to the load. Corresponding solar savings fractions ranged from 0.27 (Seattle) to 0.64 (Phoenix). System efficiency decreases significantly as area and solar savings fraction increase beyond the base case. Night insulation (R9) increases base case delivered energy by about 20% in cold and warm climates. Freezing is unlikely except in the coldest climates. If the installed cost of the single-glazed, selective unit is $420 after tax credits, the simple payback period when displacing electricity is about 5 years in all cities except Seattle.

30539 Results of testing and modeling passive solar DHW systems. Robison, D.; Reichmuth, H. (Oregon Dept. of Energy, Salem, OR). pp 771-776 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

Comparisons of test results and simulations for batch and thermosiphon passive solar DHW systems. The simulation model is a thermal network model using simplified heat up and cool down tests to establish the efficiency parameters. Simulated results are compared with the SRCC-200 test results and field data. A comparison shows that the simplified tests give equivalent results to the SRCC rating method and, in addition, are capable of predicting performance under a wide range of climatic and usage conditions. Corraboration of the model demonstrates that it can predict individual draws, daily energy outputs and annual solar performance to a high degree of accuracy. Results are also compared to the California PUC method of calculating performance estimates.

30540 The optimization of a commercial refrigeration system (with ambient cooling, ice storage and superinsulation). Amistadi, H.R. (EnerCrop, Burlington, VT). pp 743-748 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

The proposed system will utilize winter climate as an annual source of cooling by taking advantage of natural ambient temperatures to freeze ice as a source for cooling. A passive freon heat pipe and ice storage system will provide the necessary cooling for refrigeration. The Refrigeration/Economic Loads Optimization Program, or RELOP, explores the various proportions of ice storage and superinsulation to discover the economically-optimized combinations of the two.

30541 Performance evaluation of a thermosiphon/blockbed system. Morris, W.S. (Morris Research and Design, Santa Fe, NM). pp 265-269 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

This paper describes the performance of a thermosiphon air collector which was designed and built to heat the masonry floors of a residence in Santa Fe, New Mexico. The system uses ten different blockbeds, composed of concrete block on their sides, to transfer the heat to the floor above. Simple monitoring techniques were employed in February of 1983 to determine typical winter day performance of this passive solar heating system, and the results are evaluated in this paper along with recommendations for future systems.

30542 Geographic limits for comfort in unassisted roof pond cooled residences. Fleischhacker, P.; Clark, G.; Giolma, P. (Solar Data Center, San Antonio, TX). pp 835-838 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

Heat load calculations for a 1224 square foot roof pond building have been made for 35 locations across the United States. Except for the roof pond feature, the building is of standard low-mass construction on a concrete slab foundation. Interior air temperature was calculated using a simple empirical method. The comfort benefits of "wet" and "dry" ponds and of ceiling fans were evaluated. The resulting interior temperatures were plotted on a map of the U.S. The plotted contours are lines to the north of which roof pond houses will provide comfortable temperatures without additional air conditioning at 6pm on a July 2 1/2% ASHRAE design day. Comfort can be achieved on such a day in a ceiling fan assisted dry roof pond residence in most of the geographic area of the U.S. Comfort is most difficult to provide with this passive system in the desert of Southwest Arizona and Southeast California.

1410 Solar Collectors And Concentrators

REFER ALSO TO CITATION(S) 30342, 30345, 30367, 30541, 30542

30543 (DOE/CS/34039—T6) Solar Energy Education. Renewable energy activities for chemistry and physics. (State Univ. of New York, Albany (USA)). [1985]. Contract AC01-77CS34039. 67p. NTIS, PC A04/MF A01; GPO Dep. File Number DE85010371.

Information on renewable energy sources is provided for students in this teachers' guide. With the chemistry and physics student in mind, solar energy topics such as absorber plate coatings for solar collectors and energy collection and storage methods are studied. (BCS)

30544 (DOE/CS/34039—T9) Solar Energy Education. Renewable energy: a background text. (New York State Dept. of Education, Albany (USA). Solar Energy Project). [1985]. Contract AC01-77CS34039. 208p. NTIS, PC A10/MF A01; GPO Dep. File Number DE85010365.

Some of the most common forms of renewable energy are presented in this textbook for students. The topics include solar energy, wind power hydroelectric power, biomass ocean thermal energy, and tidal and geothermal energy. The main emphasis of the text is on the sun and the solar energy that it yields. Discussions on the sun's composition and the relationship between the earth, sun and atmosphere are provided. Insolation, active and passive solar systems, and solar collectors are the subtopics included under solar energy. (BCS)

30545 (DOE/R2/05175—T1) Design fabrication and testing of a low cost ceramic collector panel. Final report. Earl, W.A.; Johnson, P.F.; Sisson, J.C. (New York State Coll. of Ceramics, Alfred (USA)). Feb 1983. Contract FG42-80R205175. 163p. NTIS, PC A08/MF A01; GPO Dep. File Number DE85013340.

Thesis. Submitted by J.C. Sisson.

The effects of fabrication procedures on the thermal performance of various ceramic systems for active solar applications were investigated. A shale-based structural clay body was used as a standard. This body was also coated with silicon carbide, a glossy black glaze and a matte black glaze. Metal samples used included copper, aluminum and aluminum coated with a flat black paint. Experiments were performed using a solar test box linked to an automated data acquisition system. Temperatures of samples were recorded at 3 min. intervals for 4 h solar periods. An F-statistical analysis was performed on the resulting data and was correlated with total solar emittance, total solar reflectance and monochromatic reflectance as a function of incident wavelength. The information above was also utilized in developing a computer model used to simulate the performance of various materials in active solar testing. Results suggest that a structural clay body fired to maturity and coated with a matte black glaze could be commercially useful for applications requiring large quantities of heated water.

30546 **(FRCEA-R—15) Elaboration and characterization of a sputtered copper - stainless steel - amorphous carbon solar selective surface for use in evacuated collectors.** Wyon, C.; Valignat, J. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). 1983. 23p. (DMG—98-83). NTIS (US Sales Only), PC A02/MF A01. File Number DE85751596.

A spectrally solar selective surface for use in evacuated tubular collectors has been fabricated by successively depositing: an opaque copper layer, a thin film of stainless steel and an amorphous carbon layer, by non reactive magnetron sputtering. The obtained material is particularly selective (αsub(s)>0,90; epsilonsub(300°C)<0,05) and stable up to 500°C. All these properties, associated with an easy setting to work allows to consider the use of this selective surface for mass production of high performance evacuated collectors.

30547 **(FRNC-TH—1631) Conversion coatings on stainless steels for solar energy absorbant materials. Influence of metallurgical and structural state of the metal on the properties of the films.** Benavente Garcia, R. (Toulouse-3 Univ., 31 (France)). Jul 1982. 169p. (In French). NTIS (US Sales Only), PC A08. File Number DE85751350.

The aim of this work is the development of a method for the elaboration of selective solar absorbers. The treatment of stainless steels by anodic oxidation in a solution of sulfuric acid and sulfides is examined for a chemical transformation of the surface. Metallurgical problems for the preparation of selective absorbers with foils of austenitic stainless steels are studied. Effect of work hardening and annealing on properties of conversion coatings is emphasized. Metallurgical properties, optical properties and physico-chemical nature are related. The thermal stability of the coating is excellent.

30548 **(N—85-16297) What should DOE do to help establish voluntary consensus standards for measuring and rating the performance of PV modules.** Runkle, L.D. (Jet Propulsion Lab., Pasadena, CA (USA)). Oct 1984. 54p. (NASA-CR—174265; JPL-PUBL—84-73). NTIS, PC A04/MF A01.

In response to concern expressed by the photovoltaics community over progress toward the establishment and issuance of concensus standards on photovoltaic performance measurements, a review of the status of and progress in developing these standards was conducted. It examined the roles of manufacturers, and consumers and the national laboratories funded by the U.S. Department of Energy (DOE) in supporting this effort. This was done by means of a series of discussions with knowledgeable members of the photovoltaic community. Results of these interviews are summarized and a new approach to managing support of standards activity is recommended that responds to specific problems found in the performance measurement standards area. The study concludes that there is a positive role to be played by the U.S. Department of Energy in establishing collector performance measurement standards. It recommends that DOE continue to provide direct financial support for selected committees and for research at national laboratories, and that management of the activity be restructured to increase the authority and responsibility of the consensus committees.

30549 **(NP—5770293) Technological and economic aspects of the use of plastics for solar engineering.** Binder, K. (Oesterreichisches Kunststoffinstitut, Vienna). 1979. 99p. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE85770293.

Plastics with their various properties are very valuable and low-priced "materials made to measure" in solar technology. Outstanding properties are: corrosion resistance, low-weight, excellent insulation, high transparence. The physical processes of collectors are explained and the general characteristics of plastics are outlined e.g. molecular structure, mechanical properties, corrosion and weather resistance, thermal and optical properties. Plastics are used for absorbers, covers, collector housings, thermal insulation materials for collectors, sealing material, plastic collectors. Further information on: plastics for the high-temperature range (process heat), storage facilities, heat distribution (pipe systems and radiators), absorber covers, swimming pool covers. Tables on standard prices for various materials.

30550 **(NP—5900976) Development of an inexpensive solar collector cum storage system for agricultural requirements. Final report to the Tata Energy Research Institute, Bombay for Project P041.** Garg, H.P. (Indian Inst. of Tech., New Delhi. Centre of Energy Studies). Jan 1983. 228p. NTIS (US Sales Only), PC A11. File Number DE85900976.

The effect of various climatic, design, and operating parameters for improving the performance of some fixed configuration type of conventional and novel type of solar air heaters are examined. Other improvements considered are (1) effects of expanding the heat transfer area by Porous-bed absorber, and (2) of using selective absorbercoatings (i.e. $\epsilon = 0.1$). The results obtained from the theoretical research work for conventional solar air heater and porous bed solar air heater have been used to construct a flat plate solar air heater of area 4 m^2 and a rock bed collector cum storage system, also of area 4 m^2. Both the above units have been combined together in a series installation known as augmented integrated solar collector and storage system. Performance characteristics of the augmented integrated rock collector and storage system are also included in present report. Moreover, this newely constructed (AIRS) unit is under thorough experimentation.

30551 **(SERI/PR—255-2493) Identification of chemical and physical phenomena affecting the durability of silvered polymer (PMMA) mirrors.** Schissel, P.; Neidlinger, H.H.; Czanderna, A.W. (Solar Energy Research Inst., Golden, CO (USA)). May 1985. Contract AC02-83CH10093. 42p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85012131.

Mirrors are the devices of choice in concentrating solar radiation for solar thermal applications. Efficiency requirements and economic factors dictate that the mirrors maintain high reflectance (over 90%) for many years (at least 5). Depending on the concentration ratio called for, the mirrors must have such surface perfection (specularity) that they can deliver all their reflected energy into an angle of 1 to 5 milliradians (mrad). Other design factors such as weight, flexibility (shatter resistance), and cost make silvered polymer films highly desirable for solar thermal use. The work reported here reveals some of the factors that affect the durability and performance of silvered polymer films in outdoor exposure. The results presented are based on laboratory analyses of various polymers silvered by various processes. The crucial role in degradation played by ultraviolet (uv) light is shown by several experimental results. Uv screens in the polymer improve weatherability. Inconel uv blockers improve adhesive performance. Weather-Ohmeter studies comparing exposures with and without uv radiation show more rapid degradation due to uv. Fourier transform infrared (FT-IR) studies show synergistic effects with uv, chlorine, and silver; but again control of uv is a major factor in enhancing mirror durability.

30552 **Surface analysis of silver mirrors made from organometallic solutions.** Pitts, J.R.; Thomas, T.M.; Czanderna, A.W. (Solar Energy Research Inst., Golden, CO). *Solar Energy Materials;* **11**: No. 4, 261-271(Dec 1984). Contract AC02-83CH10093.

Silver mirrors, made by decomposing organometallic resinate solutions, have been studied using surface analysis techniques to secure information about the silver/glass interface. The mirrors have also been characterized using SEM, EAX, thickness, reflectance, resistivity, accelerated corrosion testing and adhesion measurements. The mirrors exhibit excellent adhesion at the silver/glass interface and good corrosion resistance. Depth profiles using XPS, ISS and SIMS for analysis have been taken on the mirrors. From these studies, evidence for an increased silicon to oxygen ratio at the silver/glass interface is presented. In the silvering process, it is thought that the silver-containing Lewis base decomposes when in contact with glass at elevated temperatures (T > 400 deg C) to deplete the glass of surface oxygen, or silicon from the resinate deposits to enrich the glass surface. It is suspected that covalent silver to silicon bonds are formed during decomposition of the organometallic solution and reaction with the silicon rich glass surface and that these bonds are responsible for the excellent adhesion and thus, good corrosion resistance of the mirrors. (A.V.)

30553 Polymer degradation on reflecting metal films: fourier transform infrared (FTIR) reflection-absorbance studies. Webb, J.D.; Schissel, P.; Thomas, T.M.; Pitts, J.R.; Czanderna, A.W. (Solar Energy Research Inst., Golden, CO). *Solar Energy Materials;* **11:** No. 3, 163-175(Nov 1984). Contract AC02-83CH10093.

The technique of Fourier transform infrared reflection-absorption (FTIR-RA) spectroscopy has been successfully adapted to the study of bulk and interfacially activated photodegradation of several types of polymers on various metallic substrates. The technique enables qualitative and quantitative study of photochemical reaction mechanisms and rates. A controlled Environmental Exposure Chamber (CEEC), which permits collection of IR-RA spectra of the polymer/metal samples during their exposure to controlled spectral distributions of UV, temperatures, and gas mixtures, was built into the sample compartment of a Nicolet 7199 FTIR spectrophotometer. Surface analysis, gel permeation chromatography (GPC), UV spectroscopy, and UV spectroradiometry were used to complement the FTIR-RA results. (A.V.)

30554 Results of validated simulations of roof pond cooled residences. Clark, G.; Doderer, E.; Haves, P.; Loxsom, F. (Solar Data Center, Trinity Univ., San Antonio, TX). pp 823-828 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

Results based on new validated simulations of roof pond cooled residences (RPR) in 14 hot U.S. cities are reported. Radiant heat transfer dominates heat removal from the RPR interior and from the pond exterior. The RPR is a water-conserving cooling technology even in arid climates. In all but arid climates the ventilated RPR requires dehumidification to prevent mold and mildew. Ceiling condensation is frequent in humid climates. Total heat removal from the interior is only about 100-140 Btu/ft^2 day. The RPR must be very well insulated in order to maintain interior comfort conditions below PMV=0.5 in the hottest climates. Ceiling fans are essential for comfort in most climates. PMV=0.5 conditions are found to be comfortable by other recent comfort criteria.

30555 Energy savings potential of dehumidified roof pond residences. Vieira, R.K.; Clark, G.; Faultersack, J. (Trinity Univ., San Antonio, TX). pp 829-834 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

The energy displacement potential of roof pond cooling in humid climates is sensitive to the type of dehumidification equipment employed and the humidity levels allowed. This paper reports the simulated energy requirements of roof pond residences assisted by two high efficiency dehumidifier options. One dehumidifier is a vapor compression air conditioner with sensible cooling recovery by an air-toair heat exchanger (referred to as an "improved mechanical dehumidifier (IMD)"). The second option is a solar regenerated desiccant dehumidifier (SRDD). Results for 15 cities were compared to simulation results for a very energy conserving conventional house. The simulation was performed using typical April through October meterological data. Comfort was controlled to a predicted mean vote (PMV) of + or -0.2 and relative humidity was controlled to 68% or less to prevent mold and mildew growth. An IMD assisted roof pond house had energy savings of 30 to 65% in humid climates and 90% in dry climates compared to the conventional house. An SRDD assisted roof pond house had energy savings of 70 to 75% in humid climates. Conventional house peak power demand was displaced by 10 to 60% in an IMD assisted roof pond house and 50 to 75% in an SRDD assisted roof pond house. A method is given relating the energy savings to July dew point average and annual cooling degree days.

30556 Second generation point focused concentration on the next step. Hein, R.E. (Martin Marietta Denver Aerospace, Denver, CO). pp 831-835 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

Around 1975 the concept of multiple sun concentrators was starting to become more than a fantasy. In the fall of 1978, 10KWe of point focused concentrators were installed at Sandia National Laboratories, Albuquerque, New Mexico. These were considered by most as experimental. They had a 2-1/4 in. diameter silicon solar cell which was illuminated to 33 suns using an acrylic Fresnel lens which was approximately 1 ft square. Next came the "improved" second generation design. It utilized single crystal silicon float zone cells with a textured surface. Concentration had gone from 33 suns to 110-125 suns, and the Fresnel lens was less than 8 in. square. The cell had been reduced from a 2-1/4 in. diameter to approximately a 1 in. square. Cell efficiencies have gone from less than 10% to greater than 17% in the newest second generation designs. Before the second generation can be fully commercialized, work has already begun on a third generation using 400-600 sun concentration levels. It is expected these will be seen in module prototype forms by mid 1984.

30557 A vector computer graphic procedure for calculating the irradiated area of collector surfaces in buildings. Johnston, S.A. (Miami Univ., Oxford, OH). pp 71-76 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

This paper describes the strategy and mathematical algorithms used in the Solar Graphics computer program for determining the portion of a solar collector area exposed to the sun at any given time. A hidden line algorithm is used in conjunction with simple vector algebra to redraw the outline of the irradiated portion of the collector and to compute its area. Work is currently under way at the University of Wisconsin-Milwaukee to merge this capability with SHOW, an interactive computer graphic program, and with FCHART 4.0, a solar design program. The combined program that is being developed is called Solar Graphics. The vector/hidden line procedure, however, is written as a stand alone subroutine to Solar Graphics called Solar Test (SOLTST) that could be incorporated into other FORTRAN main programs with graphics capabilities.

30558 The performance of a roof-pond solar house, The New Mexico State University experience. Mancini, T.R. (New Mexico State Univ., Las Crucas, NM). pp 811-815 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

Presented in this paper are some of the results of tests performed with the New Mexico State University Passive Solar House during the summers of 1981 and 1982. The house is a roof-pond solar house in which movable insulating panels are used to control both the collection and rejection of energy for both the heating and cooling of the conditioned space. Of particular importance to the present study is the effect of several parameters on the cooling performance of the system. The results indicate that insulating air cells (even though deflated) have both positive and negative effects on the performance of the system; that an increase in the water pond depth from 7.5 to 15 cm results in a decrease in the temperature swing of the water which is approximately proportional to the increase in the thermal mass of the house; that the difference between the daily average ambient temperature and daily average water bag temperatures for water bags cooled by evaporation (in addition to convection and radiation) is twice that of the bags cooled by radiation and convection alone; and that the cooling of the house is not sensitive to the opening and closing times for the insulating panels as long as they are open during the early morning hours and closed prior to sunrise. In addition to the performance of the house in the cooling mode of operation, some of the maintenance and operational characteristics of the system are discussed.

1420 Heat Storage

REFER ALSO TO CITATION(S) 30350, 30351, 30359, 30378, 30388, 30411, 30528, 30540, 30541, 30543, 31051

30559 (BFR-R—32-1983) **Sunstore experimental house in Sigtuna. Performance measurement and assessment 1981-1982.** Platell, O.; Wikstroem, H. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1983. 44p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. File Number DE85750850.

This report describes operation, performance measurements and assessment of the Sigtuna house for the period from 1981-05-01 to 1982-05-30. The house has 126 m² of solar collectors, a ground heat store with 4223 m deep holes and a closed heat distribution system. A computerized instrumentation and recording system has been installed, continously recording temperatures in the ground, solar collector performance and solar energy yield from the two groups of solar collectors. Isotherms have been drawn for the ground heat storage at different times, and energy yield tabulated on a day-by-day basis. The results have been compared with theoretical values obtained from programs developed and used in Sunstores R and D work. Good agreement has been observed, and further improvements of the design programs have been applied. The storage capacities of individual channels in the heat store have been confirmed. Total solar energy yield during the season has been limited due to thee fact that the various zones of the heat store have not been optimally used. A low-temperature heating system has provided heat to the house.

30560 (BFR-R—35-1983) **Solar heating with seasonal heat storage in clay for 500 houses in Kristianstad. A feasibility study.** Green, E.; Goeransson, B.; Maartensson, B.G. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1983. 39p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. File Number DE85750851.

Hammar, a residential area in Kristianstad, Sweden, is found to be suited for incorporating a heat storage system into its district heating system. At present, 170 apartments are connected to the district heating system and in the future approx 175 new flats will be built and connected. In Hammar, clay layers of 15 m thickness are available for thermal storage. The thermal capacity of the clay is about 0.9 kWh/m³ and deg. C. The storage system is planned to incorporate solar collectors (on the roofs of the new buildings), the heat store and a heat pump plant for heat extraction. The existing fuel-oil boilers will be used for topping and reserve. The heat accumulator is planned to have a volume of 274000 m³ and will comprise 137000 m plastic tubes (vertically oriented) for heat injection/extraction. With a temperature difference of 8 C degrees (+20-+12 C degrees) the thermal capacity will be about 2000 MWh. The yearly heat loss will be some 400 MWh. 4000 m² of solar collector will be needed. The solar heat can either be used directly (via the heat pumps) or be stored. The solar heat/thermal store can deliver 3900 MWh/year, including the 900 MWh of electric energy used by the heat pumps. Cost estimates, pay-off time etc. are given in the report.

30561 (BFR-R—46-1983) **Bore hole heat store in rock. Investigation of an alternative heat store for the Soedertuna solar heating project.** Andersson, S.; Eriksson, A.; Johansson, S.; Ljung, L. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1983. 95p. (In Swedish). NTIS (US Sales Only), PC A05/MF A01. File Number DE85750853.

The objective of this work has been to investigate the technical feasibility of seasonal storage of heat in a borehole heat store in rock. Use of such a heat store is being considered for the Soedertuna solar heating project, (an IEA project). The work involves primarily alternative system designs, study of thermal processes and investigation of the geological and hydrological conditions associated with, and required for, a borehole heat store. Simplified economic comparisons have been carried out between heat storage in a water tank and in a borehole heat store. The results from the work show that: - A borehole heat store should incorporate temperature zoning. - Heat pumps should be included in the system. - Peak power output from the solar collectors should be smoothed out in a buffer heat store. - Geohydrological conditions are favourable at the proposed site in Soedertuna. - A fullscale borehole heat store in rock appears to be economically preferable to the water tank alternative. However, for smaller installations, the heat losses from a borehole heat store may be excessive. - A borehole heat store can be expanded in stages as required. - The environmental impact of a borehole heat store is slight. Compared with other alternatives for large scale heat storage, the borehole heat store appears to be economically competitive.

30562 (DTH-LV-MEDD—162) **Heat storage for solar heating systems.** Furbo, S. (Danmarks Tekniske Hoejskole, Lyngby. Lab. for Varmeisolering). Sep 1984. 284p. (In Danish). NTIS (US Sales Only), PC A13/MF A01. File Number DE85750804.

Danish and European test procedures for heat storages for solar heating systems have been developed. The suitability of the test procedures has been evaluated by means of calculations of the accuracies of the measurements and by means of the experiences gained by the tests. Test facilities for heat storages for solar heating systems for domestic hot water supply have been built. The accuracy of the measuring equipment of the test facilities has been investigated in detail. The type of heat storage consisting of a hot water tank with a built-in heat exchanger spiral has been investigated thoroughly. A detailed computer model simulating the thermal behaviour of this type of heat storage, in periods with heat supply as well as in periods without heat supply, has been developed. The computer model has been validated by means of experiments. Special tests as well as the above mentioned developed test procedures were used for the validation. The yearly thermal performance for small solar heating systems for domestic hot water supply has been calculated based on the Danish Test Reference Year and the validated computer model with different designs of the control system and of the heat storage. Based on these calculations it is possible to optimize the design of the heat storage. The problems concerning the stability of heat-of-fusion storages as well as a principle solving the stability, have been mentioned. Different heat-of-fusion storages making use of the principle, have been described. Two heat-of-fusion storages for solar heating systems for domestic hot water supply have been developed. These storages have been investigated by means of experiments in the test facilities. Based on these experiments it is assessed how the work concerning development of a suitable heat-of-fusion storage for solar heating systems for domestic hot water supply can be continued.

30563 (FRNC-TH—1915) **Theoretical and numerical study of a heat storage model using fusion heat.** Morel, A. (Paris-13 Univ., 93 - Villetaneuse (France)). 1981. 66p. (In French). NTIS (US Sales Only), PC A04/MF A01. File Number DE85751583.

A theoretical and numerical study of heat transfers in a heat accumulator model for a solar power station made up of a cylindrical chamber containing rows of circular tubes perpendicular to its axis containing an accumulator material with a heat carrying fluid circulating longitudinally in the chamber is developed in this thesis.

30564 (NP—5770191, pp 9.1-9.25) **Prospects of seasonal heat stores in energy system of the future.** Kielsgaard Hansen, K.; Nordgaard Hansen, P.; Ussing, V. (Danmarks Tekniske Hoejskole, Lyngby. Lab. for Varmeisolering). Jan 1984. (In Danish). NTIS (US Sales Only), PC A16/MF A01. File Number DE85770191.

Also published as DTH-LV-R-83-39.

In Technological development and its impact on the future energy system. Appendix 1. Evaluation commissioned by the Danish Ministry of Energy.

Use of different energy sources in combined heating systems will require heat storage. Pond heat stores have small heat losses during short storage periods. For seasonal storage the high-temperature store has to be over 500.000 m^3 in order to keep losses under 10%. Solar heat - based district heating will be competitive with the conventional one first when solar collectors cost 500 kr/m^2.

30565 **Advanced phase-change storage for passive solar heating analysis of materials and configuration.** Christensen, C.B. (Solar Energy Research Inst., Golden, CO). pp 693-698 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

In this paper the authors discuss the performance of phase-change materials (PCMs) as thermal storage in passive solar heating systems. The authors discuss factors, other than material properties, that affect storage performance and optimization. They also briefly describe solid-state phase-change materials (SS PCMs) and list typical material properties. Results from a parametric analysis of PCM Trombe walls and discuss the factors that limit performance are given. Configurations for enhanced PCM performance and simulation results for an idealized case are presented.

15 GEOTHERMAL ENERGY

REFER ALSO TO CITATION(S) 31126

30566 (CONF-8410179—, pp 273-283) **Status of EPRI's geothermal program.** Roberts, V.W. (Electric Power Research Institute, Palo Alto, CA). 1984. NTIS, PC A16/MF A01. File Number DE85008202.

From DOE geothermal technology conference; El Centro, CA, USA (16 Oct 1984).

The EPRI geothermal program to date has focused on resource utilization, system and subsystem performance, and geothermal fulid chemistry. Some progress highlights on binary cycle development, rotary separator turbine development, and geothermal fluid chemistry are reviewed and future program content is discussed.

1501 Resource Status And Assessment

REFER ALSO TO CITATION(S) 30583

30567 (CONF-8410179—, pp 13-28) **Overview of the US Department of Energy geothermal program.** Mock, J.E. (Dept. of Energy, Washington, DC). 1984. NTIS, PC A16/MF A01. File Number DE85008202.

From DOE geothermal technology conference; El Centro, CA, USA (16 Oct 1984).

Research and development programs sponsored by the U.S. Department of Energy on geothermal energy and resources are discussed. Present programs and future goals are detailed, and a break down of fiscal year 1985 funding is given.

30568 (CONF-8410179—, pp 189-205) **Plan for the DOE/Bechtel drilling and engineering program in the Salton Sea KGRA.** Fleming, S.M.; Lindemuth, T.E. (Bechtel National Inc., San Francisco, CA). 1984. NTIS, PC A16/MF A01. File Number DE85008202.

From DOE geothermal technology conference; El Centro, CA, USA (16 Oct 1984).

Current plans for the Geothermal Deep Drilling project are discussed including program objectives, major participants and their roles, description of the drilling site and its scientific potential, plans for drilling and data acquisition, description of facilities for brine handling and reinjection, and project schedule. The overall objectives of the program are to provide an assessment of the deep geothermal resource and to afford an opportunity for the scientific community to conduct tests during and after drilling under a parallel program sponsored by DOE, NSF, and USGS. At the conclusion of the DOE/Bechtel drilling and engineering program, a resource evaluation report will be prepared. Bechtel is prime contractor and is responsible to DOE for overall management of the drilling, well testing, and resource evaluation activities. Kennecott will supply sites for the deep well and brine reinjection well along the shores of the Salton Sea near Niland. This site should yield extremely high downhole temperatures. Plans call for drilling to a depth of approximately 10,000 feet, with drilling to begin in the first quarter of 1985. As the first activity in the Continental Scientific Deep Drilling Program, this project represents an exciting opportunity for the entire geothermal community.

30569 **(DOE/ET/28393—T8) Evaluation of low-temperature geothermal potential in north-central Box Elder County, Utah.** Davis, M.C.; Kolesar, P.T. (Utah Geological and Mineral Survey, Salt Lake City (USA)). Dec 1984. Contract AS07-77ET28393. 113p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE85009541.

The low-temperature geothermal resources of north-central Box Elder County, Utah were assessed. Exploration techniques used included chemical analyses of water from wells and springs, temperature surveys, and temperature-depth measurements in unused wells within the study area. The highest water temperatures (31°, 30°, and 29°C) recorded in this research were located in three separate geographic regions, suggesting that no single warm water occurrence dominates the study area. Total dissolved solid (TDS) concentrations ranged from 294 to 11,590 mg/l. Areas of warm water occurrences generally had TDS values of greater than 1100 mg/l. Reservoir temperatures were estimated using chemical geothermometers. Calculated temperatures ranged between 50° and 100°C. Temperature-depth measurements were logged in 16 unused wells. Thermal gradients calculated from the profiles ranged from isothermal to 267°C/km. The background gradient for the study area appears to be slightly above the average Basin and Range gradient of 35°C/km. The highest gradients were calculated for the area approximately eight kilometers west of Snowville, Utah, which is also an area of warm water. 61 refs., 15 figs., 6 tabs.

30570 **(DOE/ET/28393—T9) Summary of low-temperature geothermal studies conducted by the Utah Geological and Mineral Survey from July 1, 1977 to December 31, 1984.** Klauk, R.H. (Utah Geological and Mineral Survey, Salt Lake City (USA)). Dec 1984. Contract AS07-77ET28393. 20p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85009346.

Report of investigation No. 193.

Brief summaries of the results of studies of low-temperature geothermal areas are presented. These include state-wide studies, site-specific studies, and area studies. 26 refs., 2 figs. (ACR)

30571 **(DOE/ET/28407—T5) Geothermal investigation in Idaho. Part 14. Geochemical and isotopic investigations of thermal water occurrences of the Boise Front Area, Ada County, Idaho.** Mayo, A.L.; Muller, A.B.; Mitchell, J.C. (Idaho Dept. of Water Resources, Boise (USA)). Dec 1984. Contract AS07-77ET28407. 60p. NTIS, PC A04/MF A01; GPO Dep. File Number DE85012905.

Water Information Bulletin No. 30.

A limited chemical and isotopic investigation was undertaken and geological, geophysical, and hydrological data in the literature were reviewed to evaluate the geothermal potential of the Boise area. 68 refs., 12 figs., 4 tabs. (ACR)

30572 **(DOE/ID/12478—T9) Feasibility of geothermal applications for greenhousing and space heating on the Pine Ridge Indian Reservation, South Dakota.** Culver, G. (Oregon Inst. of Tech., Klamath Falls (USA). Geo-Heat Center). Feb 1985. Contract FG07-83ID12478. 39p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85009786.

Although little is known about the geothermal resources under the Pine Ridge Reservation, there seem to be good possibilities of a resource hot enough to provide heating for greenhouses, at least in the northeast portion of Shannon County. At the present time, there do not appear to be resources hot enough to provide direct use space heating of residential or commercial buildings near any of the existing population centers. Space heating using water source heat pumps may be economical and should be considered for new construction of larger heat users such as the proposed hospital at Pine Ridge. Further resource investigation is recommended, particularly more surface geology and water chemistry work. Test drilling will be required to confirm the availability of both direct use and heat pump required temperatures and flows. It is estimated that geothermal energy could be delivered to a greenhouse operation in northeast Shannon County for $4.71 per million Btu's. This compares to $11.67 for propane, the least expensive competing conventional fuel. Other factors such as availability of qualified labor, market demand, transportation, availability of power, etc. must be considered. 8 refs., 3 figs., 2 tabs.

30573 (LBL—18268) **Modeling of geothermal systems.** Bodvarsson, G.S.; Pruess, K.; Lippmann, M.J. (Lawrence Berkeley Lab., CA (USA)). Mar 1985. Contract AC03-76SF00098. 23p. (CONF-850312—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85012553.

From SPE annual California regional meeting; Bakersfield, CA, USA (25 Mar 1985).

During the last decade the use of numerical modeling for geothermal resource evaluation has grown significantly, and new modeling approaches have been developed. In this paper we present a summary of the present status in numerical modeling of geothermal systems, emphasizing recent developments. Different modeling approaches are described and their applicability discussed. The various modeling tasks, including natural-state, exploitation, injection, multi-component and subsidence modeling, are illustrated with geothermal field examples. 99 refs., 14 figs.

30574 (LBL—18520) **Technology transfer report: feasibility study for the use of geothermal brine in the Ashdod area, Israel.** Benson, S.M. (Lawrence Berkeley Lab., CA (USA)). Aug 1984. Contract AC03-76SF00098. 41p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85013316.

The hydrothermal potential of the Ashdod area, Israel, was evaluated to determine its suitability as the low grade energy source required to operate the Ashdod desalination plant. An estimated 1250 cubic meters per hour of 120°C brine would be adequate to supply the hot water necessary for operating the desalination plant. Considerable interest in oil exploration in the Ashdod area resulted in the drilling of six wells into the Jurassic formations by Oil Exploration (Investments) Ltd. (OEL) in 1976-1980. A small amount of oil was found in two wells, Ashdod 2 and 5. The remaining wells were abandoned as "dry holes". Evaluation of the drill cuttings, cores, and the electric logs defined two lithologic units of potential interest for hydrothermal exploitation, the Zohar and Shderot Dolomites. Investigation of the hydrothermal potential of the Jurassic formations underlying the Ashdod area has revealed that the aquifer temperatures range between 85 and 92°C. The hydrologic parameters are not well defined; however the matrix permeability of the dolomites and limestones is probably between 1 and 10 md. This is insufficient permeability for a large scale pumping operation such as the one required to operate the desalination plant. Therefore, successful utilization of the resource requires the presence of significant fractures and/or connected vugs in the formation. The very low well productivity and formation plugging may indicate that permeability of the fracture zones may easily be impaired, suggesting that the fracture zones are not suitable production intervals. Until a test is conducted on a properly completed well, it is not possible to evaluate the deliverability of wells tapping these aquifers. 14 refs., 8 figs.

1502 Geology And Hydrology Of Geothermal Systems

REFER ALSO TO CITATION(S) 30585

30575 (CONF-8410179—, pp 305-317) **Tracer flow in fractures.** Horne, R.N. (Stanford Univ., CA). 1984. NTIS, PC A16/MF A01. File Number DE85008202.

From DOE geothermal technology conference; El Centro, CA, USA (16 Oct 1984).

The transport of tracers through geothermal reservoirs is primarily through fractures, and the understanding of the flow mechanisms is a key step before interpretive analysis of tracer returns is possible. Two principal mechanisms have been studied by the Stanford Geothermal Program, tracer dispersion within the fracture and tracer diffusion into the rock matrix. An experimental study of tracer dispersion has recently verified our earlier theoretical derivation for one-dimensional transport. The theoretical and experimental studies of tracer retention mechanisms have suggested a method for the interpretation of tracer return histories, and have shown remarkable correspondence with field test measurements.

30576 (CONF-8410179—, pp 319-342) **Status of the Cerro Prieto project.** Lippmann, M.J.; Manon M., A. (Lawrence Berkeley Lab., CA). 1984. NTIS, PC A16/MF A01. File Number DE85008202.

From DOE geothermal technology conference; El Centro, CA, USA (16 Oct 1984).

As part of its program in geothermal energy, funded by DOE/GHTD under the Reservoir Definition Program, Lawrence Berkeley Laboratory (LBL) has continued to carry out studies of the Cerro Prieto geothermal system and has kept abreast of the latest developments at the field. The FY1984 effort has been significantly smaller than in previous years because of the lack of a formal agreement for continued technical cooperation between DOE and the Comision Federal de Electricidad of Mexico (CFE), operator and manager of the Cerro Prieto field. The earlier agreement is expected to be signed before the end of 1984. Recent LBL studies of Cerro Prieto have been restricted mainly to analyzing field data gathered earlier and to updating the models of this geothermal field on the basis of new well data and studies performed by CFE.

30577 (CONF-8410179—, pp 344-357) **Geothermics, an alternate energy source for power generation.** 1984. NTIS, PC A16/MF A01. File Number DE85008202.

From DOE geothermal technology conference; El Centro, CA, USA (16 Oct 1984).

The history of geothermal energy development in Mexico is reviewed and current activities in geothermal development are discussed. The role that geothermal energy can play in meeting Mexico's energy needs is examined.

30578 (DOE/ID/12026—T11) **Geothermal resources of the Washakie and Great Divide basins, Wyoming.** Heasler, H.P.; Buelow, K.L. (Wyoming Univ., Laramie (USA). Dept. of Geology and Geophysics). 1985. Contract FC07-79ID12026. 63p. NTIS, PC A04/MF A01; GPO Dep. File Number DE85013004.

The geothermal resources of the Great Divide and Washakie Basins of southern Wyoming are described. Oil well bottomhole temperatures, thermal logs of wells, and heat flow data were interpreted within a framework of geologic and hydrologic constraints. It was concluded large areas in Wyoming are underlain by water hotter than 120°F. Isolated areas with high temperature gradients exist within each basin. 68 refs., 8 figs., 7 tabs. (ACR)

30579 (DOE/SF/12196—9) **Indications of mineral zoning in a fossil hydrothermal system at the Meager Creek geothermal prospect, British Columbia, Canada, from induced polarization studies.** Ward, S.H.; Zhao, J.X.; Groenwald, J.; Moore, J.N. (Utah Univ., Salt Lake City (USA). Earth Science Lab.; Ministry of Geology, Beijing (China); Utah Univ., Salt Lake City (USA). Dept. of Geology and Geophysics). May 1985. Contract AC03-84SF12196. 40p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85011962.

By measuring the induced-polarization parameters m (chargeability) and tau (time-constant) we have found evidence that the center of a presumed fossil hydrothermal system at Meager Creek, British Columbia, lies south of the main manifestation of the present-day convective hydrothermal system. What implication this finding has for development of the present-day system is unknown. However, some of the fractures formed during the development of the fossil hydrothermal system may serve as conduits for fluids of the present-day system. The analysis is limited by the lack of availability of a good subsurface distribution of core samples. Nevertheless, a surface induced-polarization survey is expected to yield information about the geometry of the fossil system. Such knowledge would have implications not only for Meager Creek but for other hydrothermal systems of Cascades volcano type. 16 refs., 15 figs., 1 tab.

30580 (NP—5770191, pp 7.1-7.20) **Heat storage. Seasonal storage in groundwater reservoirs.** Boldt, J.; Hagelskjaer, J.; Olsen, H. Jan 1984. (In Danish). NTIS (US Sales Only), PC A16/MF A01. File Number DE85770191.

EFP-81.

In Technological development and its impact on the future energy system. Appendix 1. Evaluation commissioned by the Danish Ministry of Energy.

In 1982 a demonstration groundwater reservoir storage was established. It has a capacity of about 1600 MWh and recovery effect of about 2 MW. Industrial scale cycle planned for 1983 was not realized as there were observed leaks in the clay cover layer. Storage methods are closely connected with chemical conditions, i.e. aqueous concentration of calcium carbonate, hardness etc. Aquifer storage depends on local geologic factors and dimensions of the reservoir.

1503 Geothermal Exploration And Exploration Technology

REFER ALSO TO CITATION(S) 30568

30581 (CONF-8410179—, pp 285-297) **Crustal structure and tectonics of the Imperial Valley region, California.** Fuis, G.S.; Kohler, W.M. (Geological Survey, Menlo Park, CA). 1984. NTIS, PC A16/MF A01. File Number DE85008202.

From DOE geothermal technology conference; El Centro, CA, USA (16 Oct 1984).

The US Geological Survey conducted an extensive seismic refraction survey in the Imperial Valley region of California in 1979. This region included primarily the Imperial Valley proper and West Mesa. Forty shots fired at seven shot points were recorded by 100 portable seismic instruments at typical spacings of 0.5-1 km. More than 1300 recording locations were occupied, and more than 3000 usable seismograms were obtained. We analyzed five refraction profiles, modeled an existing gravity profile across the Salton Trough, constructed a basement depth map, and produced a structure and tectonic summary map of the Imperial Valley region. Results are presented for each of these areas.

30582 (CONF-8410179—, pp 207) **Deep hole studies.** Elders, W.A. (Univ. of California, Riverside). 1984. NTIS, PC A16/MF A01. File Number DE85008202.

From DOE geothermal technology conference; El Centro, CA, USA (16 Oct 1984).

The Salton Sea Scientific Drilling Project aimed at probing the roots of the Salton Sea Geothermal Area to a depth of approximately 3.1 km is described.

30583 (DOE/ET/28393—T7) **Evaluation of low-temperature geothermal potential in Utah and Goshen Valleys and adjacent areas, Utah. Part II. Water temperature and chemistry.** Klauk, R.H.; Davis, D.A. (Utah Geological and Mineral Survey, Salt Lake City (USA)). Dec 1984. Contract AS07-77ET28393. 75p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85009344.

Geothermal reconnaissance techniques have identified five areas in Utah County warranting further investigation for low-temperature geothermal resources. One area in northern Utah Valley is along Utah Lake fault zone and includes Saratoga Hot Springs. Water temperatures within this area range from 21 to 43°C. Common ion analyses as well as B and Li concentrations indicate waters sampled in this area are anomalous when compared to other samples from the same aquifer. Two other areas in southern Utah Valley also coincide with the Utah Lake fault zone. Common ion analyses, trace element concentrations, and Cl/HCO_3 ratios distinguish these areas from all other waters in this valley. Temperatures within these southern areas range from 21 to 32°C. All three thermal areas are possibly the result of deep circulation of meteoric water being warmed and subsequently migrating upward within the Utah Lake fault zone. The Castilla Hot Springs area has been expanded by this study to include a spring located 3 mi further up Spanish Fork Canyon near the Thistle earthflow. A temperature of 50°C was recorded for this spring and chemistry is similar to Castilla. In Goshen Valley, the fifth geothermal area identified, measured temperatures range from 20 to 27°C for some wells and springs. Chemical analyses, however, do not discern the location of low-temperature geothermal reservoirs. 18 refs., 7 figs., 5 tabs.

30584 (NMERDI—2-71-4221) **Evaluation of thermal remote sensing as a low-cost regional geothermal exploration technique in New Mexico. Final report.** Inglis, M.; Budge, T.K. (New Mexico State Univ., Las Cruces (USA). New Mexico Energy Inst.; New Mexico Univ., Albuquerque (USA). Technology Application Center). Mar 1985. 53p. NTIS, PC A04/MF A01 - NMERDI Univ. of New Mexico, 457 Washington SE, Albuquerque, NM 87108. File Number DE85901266.

Airborne and satellite borne thermal infrared scanner data were analyzed for application in the exploration of geothermal resources in New Mexico. The location for this study was the East Mesa Geothermal Field near Las Cruces, New Mexico. Primary sensor was the Thermal Infrared Multispectral Scanner (TIMS) which obtained data at 10-meter resolution. Additional data for comparison came from the Heat Capacity Mapping Mission (HCMM) satellite which provided data at 600-meter resolution. These data were compared to the soils, vegetation, and geology of the area, as well as borehole temperature data in an attempt to explain temperature patterns and anomalies. Thermal infrared scanner data were found to be too sensitive to solar-induced temperature anomalies to directly reflect the presence of subsurface geothermal anomalies but may provide valuable supporting information for a geothermal exploration program. 15 refs., 16 figs., 3 tabs.

1504 Legal And Institutional Aspects

REFER ALSO TO CITATION(S) 30587, 31144, 31145, 31178

1505 Economic And Financial Aspects

30585 (DOE/CE/30784—2) **Update and assessment of geothermal economic models, geothermal fluid flow and heat distribution models, and geothermal data bases.** Kenkeremath, D. (ed.). (Meridian Corp., Falls Church, VA (USA)). May 1985. Contract AC01-83CE30784. 120p. NTIS, PC A06/MF A01; GPO Dep. File Number DE85013028.

Numerical simulation models and data bases that were developed for DOE as part of a number of geothermal programs have been assessed with respect to their overall stage of development and usefulness. This report combines three separate studies that focus attention upon: (1) economic models related to geothermal energy; (2) physical geothermal system models pertaining to thermal energy and the fluid medium; and (3) geothermal energy data bases. Computerized numerical models pertaining to the economics of extracting and utilizing geothermal energy have been summarized and catalogued with respect to their availability, utility and function. The 19 models that are discussed in detail were developed for use by geothermal operators, public utilities, and lending institutions who require a means to estimate the value of a given resource, total project costs, and the sensitivity of these values to specific variables. A number of the models are capable of economically assessing engineering aspects of geothermal projects. Computerized simulations of heat distribution and fluid flow have been assessed and are presented for ten models. Five of the models are identified as wellbore simulators and five are described as reservoir simulators. Each model is described in terms of its operational characteristics, input, output, and other pertinent attributes. Geothermal energy data bases are reviewed with respect to their current usefulness and availability. Summaries of eight data bases are provided in catalogue format, and an overall comparison of the elements of each data base is included.

30586 (DOE/ID/12192—1) **Geothermal potential for commercial and industrial direct heat applications in Salida, Colorado. Final report.** Coe, B.A.; Dick, J.D.; Galloway, M.J.; Gross, J.T.; Meyer, R.T.; Raskin, R.; Zocholl, J.R. (Chaffee Geothermal Ltd., Denver, CO (USA); Western Energy Planners Ltd., Aurora, CO (USA)). Oct 1982. Contract FC07-81ID12192. 285p. NTIS, PC A13/MF A01; 1; GPO Dep. File Number DE84014797.

The Salida Geothermal Prospect (Poncha Hot Springs) was evaluated for industrial and commercial direct heat applications at Salida, Colorado, which is located approximately five miles east of Poncha Hot Springs. Chaffee Geothermal, Ltd., holds the geothermal leases on the prospect and the right-of-way for the main pipeline to Salida. The Poncha Hot Springs are located at the intersection of two major structural trends, immediately between the Upper Arkansas graben and the Sangre de Cristo uplift. Prominent east-west faulting occurs at the actual location of the hot springs. Preliminary exploration indicates that 1600 gpm of geothermal fluid as hot as 250°F is likely to be found at around 1500 feet in depth. The prospective existing endusers were estimated to require 5.02 x 10^{10} Btu per year, but the total annual amount of geothermal energy available for existing and future endusers is 28.14 x 10^{10} Btu. The engineering design for the study assumed that the 1600 gpm would be fully utilized. Some users would be cascaded and the spent fluid would be cooled and discharged to nearby rivers. The economic analysis assumes that two separate businesses, the energy producer and the energy distributor, are participants in the geothermal project. The producer would be an existing limited partnership, with Chaffee Geothermal, Ltd. as one of the partners; the distributor would be a new Colorado corporation without additional income sources. Economic evaluations were performed in full for four cases: the Base Case and three alternate scenarios. Alternate 1 assumes a three-year delay in realizing full production relative to the Base Case; Alternate 2 assumes that the geothermal reservoir is of a higher quality than is assumed for the Base Case; and Alternate 3 assumes a lower quality reservoir. 11 refs., 34 figs., 40 tabs.

1506 Environmental Aspects And Waste Disposal

REFER ALSO TO CITATION(S) 30586

30587 (CONF-8410179—, pp 259-271) **Presentation to Department of Energy geothermal conference.** Mitchell, R.; Orfanos, S.H. (Imperial County Courthouse, El Centro, CA). 1984. NTIS, PC A16/MF A01. File Number DE85008202.

From DOE geothermal technology conference; El Centro, CA, USA (16 Oct 1984).

The history of geothermal development in Imperial County during the last decade is reviewed and some of the environmental problems that were considered important at the start of development are discussed. The environmental documentation associated with geothermal development is also discussed.

1508 Geothermal Power Plants

30588 (CONF-8410179—, pp 29-33) **Heber binary project.** Lacy, R.G.; Nelson, T.T. (San Diego Gas and Electric Co., CA). 1984. NTIS, PC A16/MF A01. File Number DE85008202.

From DOE geothermal technology conference; El Centro, CA, USA (16 Oct 1984).

Recognizing the desirability of demonstrating the operation of a commercial scale, binary cycle, geothermal power plant, San Diego Gas and Electric Company (SDG and E) has formed a consortium consisting of three California utilities, the Electric Power Research Institute (EPRI), the State of California, and the US Department of Energy (DOE) to carry out the Heber Binary Project. The overall goal of the Project is to establish the economics and prove the operational viability of the binary cycle geothermal power plant.

30589 (CONF-8410179—, pp 35-40) **Heber geothermal power project #1 - dual flash.** Jacobsen, J.E. (Dravo Construction, Inc., San Jose, CA). 1984. NTIS, PC A16/MF A01. File Number DE85008202.

From DOE geothermal technology conference; El Centro, CA, USA (16 Oct 1984).

The history of the 52 MW gross dual flash geothermal power plant in the Heber geothermal field is reviewed and construction progress to date is described. Commercial operation of the plant is scheduled for August 1985. Planning for a 2nd unit is underway.

30590 (CONF-8410179—, pp 41-50) **Magmamax power plant-success at East Mesa.** Hinrichs, T.C. (Magma Power Co., Escondido, CA). 1984. NTIS, PC A16/MF A01. File Number DE85008202.

From DOE geothermal technology conference; El Centro, CA, USA (16 Oct 1984).

The history of development of the Magmamax Power Process is reviewed. Operating experience at the East Mesa 10 MW plant since the fall of 1982 is described and some possible future improvements are mentioned.

30591 (CONF-8410179—, pp 155-169) **Progress report: the Mammoth Geothermal Project.** Holt, B.; Campbell, R.G. (Ben Holt Co., Pasadena, CA). 1984. NTIS, PC A16/MF A01. File Number DE85008202.

From DOE geothermal technology conference; El Centro, CA, USA (16 Oct 1984).

The status of construction and operation of two identical 3500 kw air-cooled binary cycle geothermal power plants in the Long Valley Known Geothermal Resources Area is reviewed.

30592 (CONF-8410179—, pp 181-187) **Development operations: hypersaline geothermal brine utilization, Imperial County, California.** Whitescarver, O.D. (Union Oil Co. of California). 1984. NTIS, PC A16/MF A01. File Number DE85008202.

From DOE geothermal technology conference; El Centro, CA, USA (16 Oct 1984).

The geothermal resources of the Imperial Valley have been recognized for over a century. But early attempts to develop these resources met with frustration and failure. The geothermal fluids here are hypersaline, causing severe scaling and corrosion. After early development attempts proved unsuccessful, the Imperial Valley was put on the back burner of geothermal development, so to speak. But interest was renewed when the world energy situation changed in the 1970's and a national priority was put on the development of alternative energy resources. The oil crises of the 1970's brought new enthusiasm -- from both the public and private sectors -- to develop this geothermal resource. In the interim, Union Oil Company had developed geothermal projects at The Geysers in northern California and in the Philippines. These projects gave us the experience and technological expertise to come back to the Imperial Valley with new confidence and knowledge to solve the special problems presented by this resource. The result was the construction of two 10,000-kilowatt flash steam electric power generating facilities in the Brawley and Salton Sea anomalies. Using private investment dollars, these ongoing geothermal operations continue to provide valuable experience and new technology for greater development of the Imperial Valley geothermal resources. Achieving commercial use of this alternative energy resource becomes more promising every day as technical and economic obstacles are overcome.

30593 (CONF-8410179—, pp 106-131) **In-line process instrumentation for geothermal power plants.** Shannon, D.W.; Robertus, R.J.; Sullivan, R.G.; Kindle, C.H.; Pierce, D.D. (Pacific Northwest Lab., Richland, WA). 1984. NTIS, PC A16/MF A01. File Number DE85008202.

From DOE geothermal technology conference; El Centro, CA, USA (16 Oct 1984).

The economics of geothermal power depend on satisfactory plant reliability and continuous operation. Plant problems and extended downtime due to corrosion failures, scale buildup, or injection well plugging have affected many past geothermal projects. If in-line instrumentation can be developed to alert plant operators to correctable problems, then the cost and reliability of geothermal power will be improved. PNL has completed a program of development of in-line corrosion and chemical instrumentation for binary cycle plants, and this technology has been used to set up a monitoring program at the Heber Binary Demonstration Power Plant. The current emphasis has shifted to development of particle meters for use on injection lines and CO_2 and pH probes for use in control of calcite scaling. Plans have been outlined to develop and demonstrate flash plant instrumentation for corrosion monitoring, scaling, steam purity, and injection line particle counting.

30594 (CONF-8410179—, pp 133-153) **Heat cycle research experimental program, FY-84.** Whitbeck, J.F. (EG and G Idaho, Inc., Idaho Falls). 1984. NTIS, PC A16/MF A01. File Number DE85008202.

From DOE geothermal technology conference; El Centro, CA, USA (16 Oct 1984).

An advanced binary cycle development program is currently being conducted by EG & G for the Department of Energy. The program is aimed at increasing the viability of producing electric power from moderate temperature resources by obtaining significant increases in conversion system performance. This report briefly describes the Heat Cycle Research Facility in which the various tests are conducted, outlines the test program, and discusses the results obtained from the experimental program to date.

1509 Geothermal Engineering

REFER ALSO TO CITATION(S) 29811

30595 (CONF-8410179—, pp 89-102) **Geothermal pumping systems.** Hanold, R.J. (Los Alamos National Lab., NM). 1984. NTIS, PC A16/MF A01. File Number DE85008202.

From DOE geothermal technology conference; El Centro, CA, USA (16 Oct 1984).

After successful field testing of a prototype pressurized lubrication system designed to prevent brine intrusion and loss of lubricating oil from the motor and protector sections of electric submersible pumps, a second-generation lubrication system has been designed, fabricated, and laboratory tested. Based on a sensitive downhole pressure regulator, this system is not depth limited and it accurately controls the differential pressure between the motor oil and the external brine. The first production lengths of metal sheathed power cable have been fabricated by Halpen Engineering and delivered to REDA for testing and evaluation. Laboratory tests performed on prototype metal sheathed cable samples have demonstrated the durability of this power cable design. The East Mesa Pump Test Facility is currently being activated for high-horsepower pumping system tests that are scheduled to commence during the first quarter of FY 85. A 300-horsepower REDA pumping system equipped with a pressure regulator controlled lubrication system and a metal sheathed power cable is being fabricated for testing in this unique facility.

30596 (CONF-8410179—, pp 209-218) **Advanced drilling development.** Kelsey, J.R. (Sandia National Labs., Albuquerque, NM). 1984. NTIS, PC A16/MF A01. File Number DE85008202.

From DOE geothermal technology conference; El Centro, CA, USA (16 Oct 1984).

A new initiative by DOE/GHTD to cost share geothermal drilling technology development is discussed. An industry group, the Geothermal Drilling Organization (GDO), has been established to provide the basis for the industry funds. Sandia National Laboratories will act as the DOE representative for these cost shared projects. The structure of the Organization is discussed as well as a preliminary list of projects that are being considered for funding.

30597 (CONF-8410179—, pp 219-245) **Advanced materials for geothermal applications.** Kukacka, L.E. (Brookhaven National Lab., Upton, NY). 1984. NTIS, PC A16/MF A01. File Number DE85008202.

From DOE geothermal technology conference; El Centro, CA, USA (16 Oct 1984).

Among the most pressing problems constraining the development and expanded use of geothermal energy resources for electric power generation is the lack of satisfactory component and system reliability. This is due to the unavailability, on a commercial scale, of cost-effective materials that can function in a wide range of geothermal environments and to the unavailability of a comprehensive body of directly relevant test data or materials selection experience. In 1976, the GHTD started the Geothermal Materials Program to address materials-related problems, and since 1978 Brookhaven National Laboratory has provided technical and managerial assistance in the implementation of the effort. Major successes have been attained in the development of elastomers for high-temperature applications and in the use of polymer concrete liners for corrosion protection. Both technologies have been successfully transferred to industry. Current and planned efforts in metallic and nonmetallic materials development and corrosion protection are summarized.

30598 (CONF-8410179—, pp 171-180) **Geothermal well stimulation program and experiments in the Imperial Valley.** Verity, R.V. (Republic Geothermal, Inc., Santa Fe Springs, CA). 1984. NTIS, PC A16/MF A01. File Number DE85008202.

From DOE geothermal technology conference; El Centro, CA, USA (16 Oct 1984).

Republic Geothermal, Inc. and its subcontractors have planned and executed laboratory studies and eight well stimulation field experiments under the Geothermal Reservoir Well Stimulation Program. The program, begun in February 1979, has concentrated on extending petroleum industry stimulation technology for use by the geothermal industry. Two of the eight field experiments were performed in a well in the East Mesa field of the Imperial Valley. Stimulation of well East Mesa 58-30 provided the first geothermal well fracturing experience in a moderate temperature (350°F) reservoir with matrix-type rock properties. The two experiments consisted of a hydraulic fracture treatment of a deep, low-permeability zone and a staged hydraulic fracture treatment of a high-permeability mud and cement-damaged zone in the same well. Both treatments were technically and economically successful, and together doubled the producing rate of the previously marginal producer. Overall results of the program have shown that stimulation is viable where adequate reservoirs are penetrated by wells encountering formation damage or locally tight formations. However, wells in marginal naturally fractured reservoirs have not been saved by the types of well stimulation jobs performed thus far.

30599 **(DOE/NV/10150—6) Analysis of flow data from the T-F and S/DOE Gladys McCall No. 1 well. Final report.** Pritchett, J.W.; Riney, T.D. (S-Cubed, La Jolla, CA (USA)). Jan 1985. Contract AC08-80NV10150. 98p. NTIS, PC A05/MF A01; GPO Dep. File Number DE85009464.

The flow and bottomhole pressure data have been analyzed for the two sands (Nos. 8 and 9) tested by the Gladys McCall No. 1 Well. The more productive sand (No. 8) appears to be bounded by two linear faults at distances of ~740 ft and ~1360 ft from the well and there appears to be a decrease in the formation transmissivity away from the well. The formation properties inferred from the well test analysis have been used with a reservoir simulator to match the bottomhole drawdown/buildup history measured during the Reservoir Limits Test of Sand Zone No. 8. Wellhead pressure data measured during the long-term production testing of Sand Zone No. 8 have been employed to estimate the corresponding downhole pressures. The simulation model based solely on the Reservoir Limits Test is found to be in remarkably good agreement with the estimated bottomhole pressures for the first six months of production testing, but enlargement of the reservoir volume, by moving the boundary most remote from the well outward, is required to adequately match the full production history. The added remote volume corresponds to an increase by a factor of three in the estimated reservoir volume. The results for the Gladys McCall well are discussed in the context of earlier results determined from testing the other through geopressured geothermal design wells (Pleasant Bayou No. 2, Amoco Fee No. 1 and L.R. Sweezy No. 1 Well). 12 refs., 36 figs., 7 tabs.

30600 **(EGG-ELS—6845) Physical model studies of dispersion in fracture systems.** Hull, L.C. (EG and G Idaho, Inc., Idaho Falls (USA)). Apr 1985. Contract AC07-76ID01570. 84p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85011677.

The purposes of the laboratory-scale fracture network experiments are to study mechanisms controlling solute transport under conditions of known fracture parameters, to evaluate injection-backflow test procedures under conditions of known reservoir parameters, and to acquire data for validation of numerical models. Validation of computer codes against laboratory data collected under controlled conditions provides reassurance that the codes deal with important processes in a realistic manner. Preliminary simulations of the dual-permeability physical model have been made using the FRACSL reservoir code. These simulations permit locating electrodes and piezometers in the most advantageous positions to record tracer migration and pressure response. Much of the physical modeling effort this year was oriented towards validating the particle tracking algorithm used in FRACSL, and developing a better theoretical understanding of transport processes in fractures. Experiments were conducted in single fractures and single fracture junctions, and data on tracer migration collected. The Prickett, Naymik, and Lonnquist Random Walk aquifer simulation program has been modfied to simulate flow in single fractures. The particle tracking algorithm was also used to simulate infinite parallel plates under conditions where analytical solutions to the transport equation could be derived. The first case is for zero diffusion in the fracture, and transport based on a parabolic velocity profile. The second case is for diffusion homogenizing the tracer solution across the fracture. The particle tracking algorithm matched both analytical solutions quite well, with the same grid for both simulations. 48 refs., 41 figs., 2 tabs.

30601 **(SGP-TR—78) Experimental determination of the effective Taylor dispersivity in a fracture.** Gilardi, J.R. (Stanford Univ., CA (USA). Stanford Geothermal Program). Jun 1984. Contract AT03-80SF11459. 84p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85009922.

The applicability and accuracy of the approximation for Taylor Dispersion was experimentally determined for the diffusion of a chemical tracer in flow through a fracture. 12 refs., 16 figs., 10 tabs. (ACR)

30602 **(SGP-TR—80) Depletion modeling of liquid dominated geothermal reservoirs.** Olsen, G. (Stanford Univ., CA (USA). Stanford Geothermal Program). Jun 1984. Contract AT03-80SF11459. 144p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE85009923.

Depletion models for liquid-dominated geothermal reservoirs are derived and presented. The depletion models are divided into two categories: confined and unconfined. For both cases depletion models with no recharge (or influx), and depletion models including recharge, are used to match field data from the Svartsengi high temperature geothermal field in Iceland. The influx models included with the mass and energy balances are adopted from the petroleum engineering literature. The match to production data from Svartsengi is improved when influx was included. The Schilthuis steady-state influx gives a satisfactory match. The finite aquifer method of Fetkovitch, and the unsteady state method of Hurst gave reasonable answers, but not as good. The best match is obtained using Hurst simplified solution when $\lambda = 1.3 \times 10^{-4}\ m^{-1}$. From the match the cross-sectional area of the aquifer was calculated as 3.6 km^2. The drawdown was predicted using the Hurst simplified method, and compared with predicted drawdown from a boiling model and an empirical log-log model. A large difference between the models was obtained. The predicted drawdown using the Hurst simplified method falls between the other two. Injection has been considered by defining the net rate as being the production rate minus the injection rate. No thermal of transient effects were taken into account. Prediction using three different net rates shows that the pressure can be maintained using the Hurst simplified method if there is significant fluid reinjection. 32 refs., 44 figs., 2 tabs.

30603 **(SGP-TR—81) Tracer test analysis of the Klamath Falls geothermal resource: a comparison of models.** Johnson, S.E. (Stanford Univ., CA (USA). Stanford Geothermal Program). Jun 1984. Contract AT03-80SF11459. 116p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE85009924.

Two tracer tests on doublet systems in a fractured geothermal system were carried out in Klamath Falls, Oregon. The purpose of the tests were to obtain data which would lead to information about the reservoir and to test the applicability of current tracer flow models. The results show rapid breakthrough times and indicate fracture flow with vigorous mixing of injector fluid before production of same. This leads to the idea that thermal breakthrough is not directly related to tracer breakthrough in the Klamath Union doublet system. There has been no long-term enthalpy loss from exploiting the resource for 40 years. In order to reduce the data, models were developed to analyze the results. Along with a porous media flow model two mathematical models developed to analyze fractured geothermal systems are used to help decipher the various tracer return curves. The flow of tracers in doublet systems was investigated. A mathematical description is used for tracer flow through fractures as a function of time and various nonlinear parameters which can be found using a curve fitting technique. This allows the reservoir to be qualitatively defined. These models fit the data well, but point to the fact that future improvement needs to be considered for a clearer and more quantitative understanding of fractured geothermal systems. 22 refs., 32 figs., 11 tabs.

30604 **(SGP-TR—83) Linear boundary detection using pressure buildup tests.** Fox, G. (Stanford Univ., CA (USA). Stanford Geothermal Program). Jun 1984. Contract AT03-80SF11459. 48p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85009926.

Linear boundary detection has received considerable attention in the past. Although linear boundaries are frequently suspected and observed in well tests, conventional interpretation methods rely upon the development of two straight lines, which may not occur in practice. This report introduces two new semilog type curve matching methods for finding the distance to linear boundaries using buildup tests. Idealized curves are plotted from analytical solutions generated using the image well concept. These curves are then collapsed mathematically to a single type curve. By matching field data to the semilog type curve, the distance to a linear boundary may be estimated. The new methods have distinct advantages. The transition zone is the most important feature of the pressure response for type curve matching. Since development of the second straight line is not required, the range of interpretable tests is greatly extended. No estimates of reservoir characteristics are required to calculate the distance to the boundary because dimensionless parameters are used. 23 refs., 15 figs., 1 tab.

1510 Direct Energy Utilization

REFER ALSO TO CITATION(S) 30572, 30574, 30586

30605 (CONF-8410179—, pp 299-304) **Commercialization of geothermal energy: a new frontier.** Kerrigan, J.W. (Ultrasystems Inc., Irvine, CA). 1984. NTIS, PC A16/MF A01. File Number DE85008202.

From DOE geothermal technology conference; El Centro, CA, USA (16 Oct 1984).

The application of geothermal energy has thus far been primarily limited to electrical power generation. The UltraSweet Project represents a bold step to apply current technology to a normal industrial manufacturing plant. Backed by the DOE, this project represents a major advance, involving a cooperative lender and imaginative developer. When successful, new industries can substantially impact the Imperial Valley. This project involves almost $90 million and will be the largest industrial plant in Imperial County.

30606 **(DOE/ID/12478—T10) Haystack Resources Company: greenhouses, near Boulder, Colorado.** Culver, G.; Rafferty, K. (Oregon Inst. of Tech., Klamath Falls (USA). Geo-Heat Center). May 1985. Contract FG07-83ID12478. 31p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85013125.

Design specifications for an agricultural center where greenhouses will be supplied with geothermal water and heating systems are evaluated. (ACR)

1520 Geothermal Data And Theory

REFER ALSO TO CITATION(S) 30585, 32389

30607 (SGP-TR—77) **Characterization of retention processes and their effect on the analysis of tracer tests in fractured reservoirs.** Walkup, G.W. Jr. (Stanford Univ., CA (USA). Stanford Geothermal Program). Jun 1984. Contract AT03-80SF11459. 107p. NTIS, PC A06. File Number DE85009921.

Retention processes such as adsorption and diffusion into an immobile region can effect tracer movement through a fractured reservoir. This study has conducted experimental work and has developed a two-dimensional model to characterize retention processes. A method to directly determine some important flow parameters, such as the fracture aperture, from the analysis of tracer tests has been developed as a result of the new two-dimensional model. The experimental work consisted of batch experiments designed to both reproduce earlier work and to determine the magnitude of the retention effects. Negligible retention was observed from which it was concluded that the batch experiments were not sensitive enough and that more sensitive flowing tests were needed. A two-dimensional model that represents a fractured medium by a mobile region, in which convention, diffusion, and adsorption are allowed, and an immobile region in which only diffusion and adsorption are allowed has been developed. It was possible to demonstrate how each of the mass-transfer processes included in the model affect tracer return curves by producing return curves for any set of the defining variables. Field data from the New Zealand was numerically fit with the model. The optimum values of the parameters determined from curve fitting provided a direct estimate of the fracture width and could be used to estimate other important flow parameters if experimentally determinable values were known. 25 refs., 22 figs., 6 tabs.

30608 **Prehnite - epidote equilibria and their petrologic applications.** Liou, J.G.; Kim, H.S.; Maruyama, S. (Stanford Univ., CA). *Journal of Petrology;* **24**: No. 4, 321-342(Nov 1983). Contract FC07-80ID12148.

The stability relations of prehnite and epidote were experimentally determined for the bulk composition of $Ca_2Al_2FeSi_3O_{12}(OH)$ + excess H_2O using conventional hydrothermal apparatus and solid oxygen buffer techniques. Three starting materials were used: (I) mixtures of natural prehnite and hematite, (II) mixtures of synthetic epidote and natural prehnite + hematite in subequal proportion; and (III) reground run products. Over a range of f/sub o_2/ , epidote was readily synthesized from starting material (I) at 500-550°C, 5-8 kb P/sub fluid/, run duration of 7 to 45 days, and prehnite grew at the expense of its high-T epidote assemblage at temperatures below 350°C, 2-8 kb, run duration of 20 to 50 days. Microprobe analyses indicate that the $Fe^{3+}/(Fe^{3+} + Al)$ ratios of synthetic epidotes and prehnites vary as a function of f/sub o_2/ and temperature. Both epidote and prehnite are most iron-rich at 325°C and 2 kb, 353°C and 5 kb and 373°C and 8 kb and f/sub o_2/ of the HM buffet. The phase relations of prehnite and epidote are defined by continuous reactions where a transition zone between the garnet-in reaction and the prehnite-out reaction occurs at 325-343°C, 2 kb, 353-375°C, 5 kb and 373-395°C, 8 kb P/sub fluid/ and f/sub o_2 of the HM buffer. The minimum stability for the garnet-bearing assemblages is defined by the garnet-in reaction, and the maximum stability for the prehnite-bearing assemblages by the prehnite-out reaction. Sliding equilibria involving phases with continuous change in composition apparently are common for low-grade metamorphism. 49 references, 9 figures, 7 tables.

16 TIDAL AND WAVE POWER

1608 Wave Energy Converters

REFER ALSO TO CITATION(S) 30356

30609 (EFN-LET—1983-02) **Cage rotor induction machine with controllable power factor.** Zweygbergk, S. von. (Energiforskningsnaemnden, Stockholm (Sweden)). 1983. 44p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85750829.

The machine can supply its own demands of reactive power. The need for condensers and/or phasecompensators can therby be eliminated or considerably reduced. This can be attractive if the machine is working as a generator in a wave converter, where distance to land often is considerable. Since the generator can work with a power factor almost equal to one, the consumption of copper for the transfer cable to land can be reduced quite essentially. This report presents briefly the basic principles of the SCIM-machine, covers derivation of the analytical expressions for the flux density in the airgap of the machine and gives the basis of calculation for the reactive power produced by the machine. In summing up, the following can be said about this new type of machine: a) It has been shown both analytically and experimentally that the machine can work with controllable power factor and under certain circumstances even supply the grid with reactive power. b) The machine is still at laboratory stage. The two test machines of conventional design which have been built, have been made by rewinding of conventional machines. Test results gained so far indicate that the aim to obtain a considerably improved power factor has been achieved in these machines, however at the expense of a somewhat lower efficiency. Since the mode of operation of the machine premises a certain discontinuity in the stator winding, it can be comprehended that the efficiency of such a machine always will be somewhat lower than in a conventional machine with about the same material. It is however possible that the improved power factor fully balances this drawback.

17 WIND ENERGY

1701 Availability (climatology)

REFER ALSO TO CITATION(S) 30637, 30640, 30641, 30642

30610 (STEV-TFS—83-8) **Renewable energy sources wind and solar energy in electrical energy systems. Development of methods.** Soeder, L. (Statens Energiverk, Stockholm (Sweden)). Aug 1983. 67p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. File Number DE85750847.

This work describes the effects of adding the power output from energy sources which vary stochastically in time. Only wind power is treated, but the conclusions are relevant also for wave power and solar power. In the calculations, analytical methods have been used, i.e. wind data expressed as distributions or frequencies rather than time series, that are used in simulations.

30611 (STEV-VIND—84-3) **Gusts. Introductory statistical treatment.** Bergstroem, H. (Statens Energiverk, Stockholm (Sweden)). 1983. 23p. (In Swedish). NTIS (US Sales Only), PC A02/MF A01. File Number DE85750816.

Four measurements of one hour duration each of the atmospheric turbulence have been analysed. The amplitude of gusts has approximately gaussian distribution. Standard deviation of the amplitude of the difference of velocities is also a function of time differences. A gust with a large amplitude has also a long duration. Calculations are presented for the surpassing of certain amplitude limits for a predeterminated time. The distribution and spectra of wind velocity of the site should then be well documented.

30612 **(STEV-VIND—84-5) Wind variations on a long time scale at Naesudden.** Smedman, A.S. (Statens Energiverk, Stockholm (Sweden)). 1983. 15p. (In Swedish). NTIS (US Sales Only), PC A02/MF A01. File Number DE85750818.

The variations affect the power production and the routines of stop and go. The spectral gap could vanish and high turbulence will result. At stable layering, gravitational waves may cause sluggish variations. A comparison of normalized frequencies of the maximum and minima of wind velocity spectra at Naesudden and Marsta is presented.

30613 **(STEV-VIND—84-6) Wind-climatic study of profile measurements at Naesskaer.** Bergstroem, H. (Statens Energiverk, Stockholm (Sweden)). 1983. 19p. (In Swedish). NTIS (US Sales Only), PC A02/MF A01. File Number DE85750819.

Data from a 30 m mast have been used to calculate the wind profile at the height of 100 m by using a model theory of similarities. The medium wind velocity was calculated to be 9.2 m per s 100 m above the sea. The highest velocities exist during autumn and winter. The data are valid for the northwestern Baltic Sea, 10 km from the coast. Measurement from Gotland indicate that low-level jets at the height of between 100 m and 300 m are common phenomena at the Baltic Sea.

30614 **(STEV-VIND—84-18) Measurement of wind on high masts. Quarterly report 4/1983.** Kvick, T.; Andersson, H. (Statens Energiverk, Stockholm (Sweden)). Feb 1984. 33p. (In Swedish). (SMHI-MK—1984-7). NTIS (US Sales Only), PC A03/MF A01. File Number DE85750868.

The number of measuring stations has been reduced from April 1983 to 5 masts. Wind speed and wind direction is presented on graphs and tables.

1704 Economics

30615 (CONF-8102114—Summ., pp I.75-I.89) **Recommended procedure for a description of cost of energy from WECS. Preliminary proposal.** Nitteberg, J. (Institutt for Energiteknikk, Kjeller, Norway). Apr 1981. NTIS (US Sales Only), PC A05/MF A01. File Number DE85750807.

From IEA expert meeting on recommended practices for wind turbine performance testing; Geilo, Norway (19 Feb 1981).

In connection with the evaluation of energy costs, work on the IEA Energy Systems Analysis Project has given a systematic method of technical, economical and environmental characterization of energy technologies. This Standard Method of Technology Characterization (SMTC) agreed upon among experts of diverse professions from roughly 15 IEA member countries, made it possible to compare different technologies in a consistent way. In the following presentation, the SMTC will be outlined together with comments and advice on how it can be applied to wind energy and in particular on it's application to calculating the cost of wind energy. The EMTC is built up around a Standard Table of Characteristics (STC) containing well defined technical, economical and environmental parameters. Together with the STC there is also - A general description of the technological process and system. - A list of comments to the data given in the STC. The idea is that the inclusion of these three items should give sufficient information for the user to find out how the data is derived and from where it had its origin.

1705 Environmental Aspects

30616 **(NE-VIND—83-18) Ecological effects caused by wind power situated at sea. A summary.** Grimaas, U. (Naemnden foer Energiproduktionsforskning, Stockholm (Sweden)). 1983. 14p. (In Swedish). NTIS (US Sales Only), PC A02/MF A01. File Number DE85750827.

The effects may come into existence both during constructional activities and at normal operation. These shallow sea areas which may be exploited should become full of changes. The disturbance of the playground for fish and of fishing is discussed. It might be interesting to learn how fish and seals conceive sound and make use of it. Seals seem to avoid the coast where wind power has been established. The migration of birds should be observed. Comparative evaluations of regions become great interest.

30617 **(RISO-M—2449) Retrospective glance of a boundary layer wind tunnel experiment 25 years ago.** Petersen, H. (Risoe National Lab., Roskilde (Denmark)). Jul 1984. 14p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85750796.

This report is a reprint of the contents of the paper "A type of wind tunnel for simulating phenomena in the natural wind", AGARD-report No. 308, 1960, and is issued on the occasion of the 25th anniversary of the experiments described. They were the first experiments in Denmark that modelled part of a town, Copenhagen, in a boundary layer wind tunnel designed for that specific task with the aim of investigating the distribution over the city of the emmission from a high factory chimney stack. At the time, 1959, the common interest in environmental problems was not very pronounced. However, the TUBORG brewery insisted on documentation for the selection of the height of a new chimney stack at the factory, sufficiently high to avoid causing any nuisance to the population in the surroundings, and so took the initiative of having the experiments realized.

1706 Wind Energy Engineering

REFER ALSO TO CITATION(S) 30367, 30504, 30544, 30666

30618 **(CONF-8102114—Summ.) Summary report from the IEA expert meeting on recommended practices for wind turbine performance testing.** Frandsen, S. (ed.). (Risoe National Lab., Roskilde (Denmark)). Apr 1981. 99p. NTIS (US Sales Only), PC A05/MF A01. File Number DE85750807.

From IEA expert meeting on recommended practices for wind turbine performance testing; Geilo, Norway (19 Feb 1981).

The report from IEA expert meeting contains 3 papers on proposals for recommended procedures for wind turbine performance testing, including cost of energy from wind turbines.

30619 (CONF-8102114—Summ., pp I.11-I.46) **Interim international recommended procedures for Wind Energy Conversion Systems performance testing.** Trenka, A.R. (Test Operations, Wind Systems Branch, Rockwell International, Golden, Colorado, USA). Apr 1981. NTIS (US Sales Only), PC A05/MF A01. File Number DE85750807.

From IEA expert meeting on recommended practices for wind turbine performance testing; Geilo, Norway (19 Feb 1981).

This document describes a proposed interim procedure for determining and reporting certain of the above described performance characteristics of Wind Energy Conversion Systems (WECS). It provides the consumer/purchaser with an equitable basis for comparing the energy production characteristics of WECS available in the marketplace. 1) The methods are not limited to WECS that produce electricity. 2) These procedures and practices are generally applicable to WECS of all sizes and classifications. 3) Specific procedures and presented for each step in the rating process. Alternate procedures, however, are allowed where indicated if documentation demonstrating their equivalence is provided. 4) This document does not address issues of safety reliability, durability, economics, noise or electromagnetic interference. These will be addressed in separate documents.

30620 (CONF-8102114—Summ., pp I.47-I.73) **Recommended practices for wind turbine performance testing. Preliminary proposals for sub-section on wind speed/power measurements.** Frandsen, S. (Risoe National Laboratory, Roskilde, Denmark); Maribo Pedersen, B. (Technical University of Denmark, Lyngby, Denmark). Apr 1981. NTIS (US Sales Only), PC A05/MF A01. File Number DE85750807.

From IEA expert meeting on recommended practices for wind turbine performance testing; Geilo, Norway (19 Feb 1981).

In the present paper some proposals as to the contents of the "recommended practices" are put forward. The paper shall be considered as a first draft, incomplete in many places, but hopefully sufficient as a basis for detailed discussions. The present proposals consider primarily long term measurements, which should give the most accurate information for the above-mentioned users. Additional recommendations, when making short term measurements, are thus left out for the present. What is discussed are the methods to be used in determining - the power curve of a wind turbine. - the mean power output or annual energy production. - the percentage of time in which the turbine is operating or the power duration curve.

30621 (DOE/NASA/20320—64) Effect of precipitation on wind turbine performance. [Final report]. Corrigan, R.D.; DeMiglio, R.D. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center; Sverdrup, Inc., Middleburg Heights, OH (USA)). May 1985. Contract AI01-76ET20320. 21p. (NASA-TM—86986). NTIS, PC A02/MF A01; GPO Dep. File Number DE85013105.

During performance testing on the NASA/DOE Mod-0 100 kW wind turbine, a decrease in rotor power was noted during adverse weather conditions (rain, snow, etc.). A review of the test results indicated this decrease could be attributed to the effects of precipitation on the rotor. Because the decrease in performance was significant, additional tests were run to measure and compare the rotor power with and without precipitation. This report presents both the experimental and analytical analysis of the effects of precipitation on wind turbine performance. The tests were conducted on the two-bladed Mod-0 horizontal-axis wind turbine with three different rotor configurations. Experimental data from these tests are presented which indicate that rainfall degraded the performance of all three rotors. Light rainfall degraded performance by as much as 20 percent at higher windspeeds while heavy rainfall degraded performance by as much as 30 percent. Snow mixed with drizzle degraded performance by as much as 36 percent at low windspeeds. The theoretical analysis which was used to predict the effect of rain on wind turbine performance was based on a blade-element/momentum code with airfoil characteristics modified to account for the effect of rain. The predictions were made for one of the three rotor configurations tested and indicated a loss in performance of 31 percent at high windspeeds with moderate rainfall rates. These predicted results agreed well with experimental data.

30622 (DOE/R0/00451—T1) [Wind turbine]. Final technical report. (Blind Canyon Aquaranch, Hagerman, ID (USA)). [1985]. Contract FG48-80R000451. 84p. NTIS, PC A05. File Number DE85011336.

The development and testing of a wind turbine is reported in this paper. The designs and materials used to manufacture the wind turbine are engineered to produce a machine which is relatively inexpensive and easily manufactured.

30623 (DOE/R1/23278—T1) Design of a unique wind powered heating system. Cromack, D.; Po, M.A. (Massachusetts Univ., Amherst (USA). Dept. of Mechanical Engineering). 1982. Contract FG41-81R123278. 22p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85013350.

The design of an entire wind turbine system utilizing a mechanical churn as the sole means of energy conversion has been completed. The system has been designed to meet the hot water demands of a 100 cow dairy farm which consumes 68,500 kW-hrs of energy yearly in the form of hot water. The hot water produced by this system will be used to provide space heating, livestock facility and milk processing equipment sanitation, and hot tap water. The wind turbine is designed for a moderate average wind speed of 6 m/s. It should be noted that this system could be used for other industrial applications where the energy demand for process hot water is similar to that of the dairy farm.

30624 (DOE/R3/06112—T1) Sailmill water pump. Quarterly and final report. Dorr, R. (Dorr (Ralph), Danville, VA (USA)). 24 Sep 1980. Contract FG43-79R306112. 51p. NTIS, PC A04. File Number DE85008993.

The design, construction and testing of a sailmill water pump are presented. Two different sailmills were designed and built with interchangeable components. The original model (Sailmill I) has rotating crankshafts with sails fixed at one end, while the Sailmill II employs a fixed crankshaft with rotating sails. Both models were tested in the North Carolina State flume and in a plywood flume built in a creek. Results of the tests are provided and show that neither sailmill could meet the desired effect of pumping 50,000 gallons of water a day to a height of 25 feet. The design plans and sketches for the construction of the sailmills are included in the report. (BCS)

30625 (EPRI-AP—4060-Vol.1) Goodnoe Hills Mod-2 Cluster Test Program. Volume 1. Energy production performance, availability, and reliability. Final report. Bovarnick, M.L.; Nielson, R.L.; Poore, R.Z.; Wiesner, W. (Boeing Aerospace Co., Seattle, WA (USA)). May 1985. 137p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920159.

The cluster of three Mod-2 wind turbines was installed at Goodnoe Hills, Washington, in 1980 and 1981. The machines were built for the US Department of Energy by Boeing and were formally accepted by the government in 1982. Electric Power Research Institute (EPRI) contracted with Boeing in November 1982 to conduct several tests and analyses as a part of its comprehensive evaluation of wind turbines. This document is one of three volumes that constitute the final report of this effort. Volume 1 addresses energy capture performance predictions, in-line performance degradation, performance evaluation methods, and 1982 component reliability evaluation.

30626 (EPRI-AP—4060-Vol.2) Goodnoe Hills Mod-2 cluster test program. Volume 2. Structural and mechanical loads tests and analyses. Final report. Bovarnick, M.L.; Shipley, S.A.; Finger, R.W. (Boeing Aerospace Co., Seattle, WA (USA)). May 1985. 144p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920198.

Boeing, under contract to the Electric Power Research Institute (EPRI), has completed a test and analysis program on the Mod-2 wind turbines at Goodnoe Hills, Washington. The goal was to make a structural and mechanical assessment of the machines. This was accomplished by updating the loads data base and determining the effects of site and machine differences and vortex generators on fatigue life estimates. Two yaw loads alleviation techniques were also evaluated. This report briefly describes the test setup and loads instrumentation, but it emphasizes the loads data comparisons and their relevance to Mod-2 fatigue life estimates. Comparisons of these data with dynamic loads data from a similar test program on the Pacific Gas and Electric Company (PG and E) Mod-2 wind turbine in Solano County, California, are included to illustrate site differences. Pretest predictions based on the DYLOSAT computer program are shown. Mean and fatigue load spectra in the form of wind bin plots are developed for the major structural components to compare data. The report concludes with an assessment of the importance of vortex generators, site dependence, and machine differences on fatigue load and life predictions. The adequacy of structural analysis methodology used on Mod-2 is evaluated, and recommendations are made to improve this methodology for application to horizontal-axis wind turbine design.

30627 (FRNC-TH—1914) Study of the performance of a wind mill in presence of a wind gradient. Zahran, M. (Toulouse-3 Univ., 31 (France)). 1982. 317p. (In French). NTIS (US Sales Only), PC A14/MF A01. File Number DE85751586.

The different aspects of the operation of wind-powered motors of large diameter have been analyzed. A parametric study of the wind-powered motor is then developed: influence of wedging, operating relation, mean and geometry of the blade. The influence of the wind gradient on performance is studied. A mathematical model enabling a detailed description of the shape of the wake is described and the induced velocities of the rotor plane at infinity are calculated. An experimental study of the velocity distribution in a meridian plane downstream of the rotor, with and without wind gradient is finally presented.

30628 (N—85-16301) Development of large wind energy power generation system. (National Aeronautics and Space Administration, Washington, DC (USA)). Jan 1985. 20p. (NASA-TM—77779). NTIS, PC A02/MF A01.

The background and development of an experimental 100 kW wind-energy generation system are described, and the results of current field tests are presented. The experimental wind turbine is a two-bladed down-wind horizontal axis propeller type with a 29.4 m diameter rotor and a tower 28 m in height. The plant was completed in March, 1983, and has been undergoing trouble-free tests since then. The present program calls for field tests during two years from fiscal 1983 to 1984. The development of technologies relating to the linkage and operation of wind-energy power generation system networks is planned along with the acquisition of basic data for the development of a large-scale wind energy power generation system.

30629 (NE-VIND—83-22) **Comparative stability analysis of the blade curve of single and double-blade vertical axis turbines, respectively.** Thor, S.E.; Dahlberg, J.Aa. (Naemnden foer Energiproduktionsforskning, Stockholm (Sweden)). 1983. 51p. (In Swedish). (FFA-TN—1983-22). NTIS (US Sales Only), PC A04/MF A01. File Number DE85750828.

The radius of the turbine is 62.5 m. The calculations by the computer code STAGS show that the double blade turbine becomes unstable at load factors which are 30 percent higher than the corresponding values of a single-blade turbine. The blades are assumed to stand still and the blowing is directed towards the rotating axis. The wind load on the double-blade is assumed to be half of the single blade. Large deformations originate from the load pressure. A list of FFA reports on wind energy is presented.

30630 (PB—85-157527/XAB) **Meteorological and performance measurements on a 55-kW Vestas and a 30-kW Sonebjerg wind-turbine EC Wind Energy Programme, Action 5.** Jensen, S.A.; Bjerregaard, E.T.D.; Paulsen, U.S. (Commission of the European Communities, Luxembourg). [1985]. 83p. (EUR—9041-EN). NTIS, PC E05/MF E05.

A data-recording system was designed for measurements of meteorological data and data concerning the performance of a wind turbine. Measurements were carried out on two commercially available Danish wind turbines: a 55-kW Vestas wind turbine and a 30-kW Sonebjerg wind turbine. The test periods of the two wind turbines were approximately three months and two months, respectively. The same measuring program was carried out on both wind turbines, and consisted of: long-term measurements for the determination of wind statistics, power performance, and operation time; short-term measurements for the determination of power quality, skew wind, and brake functions; and, finally, supervision measurements in order to record the behaviour of the wind turbine during possible emergency situation.

30631 (RISO-M—2407) **Test report for Wind-Matic 14S, 55 kW. Standard measurements.** Lading, P. (Risoe National Lab., Roskilde (Denmark)). Mar 1984. 53p. (In Danish). NTIS (US Sales Only), PC A04/MF A01. File Number DE85750794.

The report contains measurements carried out using the standard test procedure. The main results are dealing with: Power curves, system efficiency, annual energy production, power regulation by stall, mechanical brake, air-brakes and loads during cut-in. Full range measurements have been done for one rotor speed, some measurements have been done for lower rotor speed, compleated with calculations.

30632 (SERI/STR—217-2584) **Addendum to a catalog of low Reynolds number airfoil data for wind turbine applications.** Miley, S.J. (Texas A and M Univ., College Station (USA). Dept. of Aerospace Engineering). Feb 1985. Contract AC02-83CH10093. 87p. NTIS, PC A05/MF A01; GPO Dep. File Number DE85008784.

The prediction of wind turbine performance requires airfoil data at Reynolds numbers lower than those used for aircraft operation. A Catalog of Low Reynolds Number Airfoil Data for Wind Turbine Applications, published in 1982 by Rockwell International Corporation, included airfoil data up to a Reynolds number of 3,000,000. After the catalog was finished, it was brought to the author's attention that the cubic spline fitting routine used in generating the curves from discrete data caused inaccuracies in some of the airfoils. A point-to-point curve fitting routing produced more accurate results. This addendum corrects the daag data for the affected airfoils, and is formatted to correlate with the original catalog.

30633 (SERI/STR—217-2629) **Development of an analytical model and code for the flapping response of a Hawte rotor blade.** Thresher, R.W.; Hershberg, E.L. (Oregon State Univ., Corvallis (USA). Dept. of Mechanical Engineering). Feb 1985. Contract AC02-83CH10093. 233p. NTIS, PC A11/MF A01; 1; GPO Dep. File Number DE85008806.

The following report is a descriptive summary of the work performed under RFP 76824 for Rockwell International's Rocky Flats, Colorado, facility as part of the Federal Wind Energy Research Program. The objectives of this project were threefold: (1) development of an analytical model of the flapping response of a wind turbine rotor; (2) development of an interactive, user-friendly computer code for performing the flapping analysis and for computing the rotor loads due to aerodynamic factors and blade flapping responses; and (3) verification of the model and the computer code with measured loads data taken from an existing machine. The model is a single-degree-of-freedom flapping response model of an individual wind turbine blade. It accounts for the blade bending deformation about the smallest blade inertia axis. The rotor is assumed to rotate at a constant speed, but the hub is allowed to move in a prescribed yawing motion. Rotors that are tilted and yawed relative to the mean wind direction can be accommodated in a straightforward manner.

30634 (STEV-VIND—83-25) **Analysis of the control problem for horizontal axis wind turbines. Final report.** Mattsson, S.E. (Statens Energiverk, Stockholm (Sweden)). Aug 1983. 52p. NT S Sales Only), PC A04/MF A01. File Number DE85750815.

This report considers control of large horizontal axis wind power plants connected to utility grids. The objective is to give a global picture of the control problem. The system dynamics and the characteristics are investigated first to find which properties that are basic to all horizontal axis wind turbines and which properties that can be influenced by process design and regulator design. Control objectives, measurements and other control issues are then discussed. The interaction between process design and regulator design is also discussed.

30635 (STEV-VIND—84-4) **Turbulence structure at prototype sites - a summary of the analysed data till now.** Smedman, A.S. (Statens Energiverk, Stockholm (Sweden)). 1983. 32p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. File Number DE85750817.

Some of characteristic features of the turbulence structure at the sites Maglarp and Naesudden are summarized. At Naesuuden the normalized spectral curves for the u, v and w components, given for uniform terrain, are valid at lower heights except for the low frequency part of the curves. At this region the spectral lag effect is noticeable. At heights over 100 m, when the wind is blowing from the colder sea, the stratification is very stable and the flow is only occasionally turbulent. At heights between 10-100 m the conditions are very variable and normalized spectral curves have their universal form but are displaced towards higher frequencies. At Maglarp the tower is situated at the top of a low and gently sloping hill. The velocity spectra can be analysed in terms of current flow over hill theory. When normalized spectra are compared with spectral curve valid for flat and homogenous terrain the following can be stated: All measured spectra have the same universal form. Spectra are displaced towards higher frequencies. Spectra higher up in the outer region contain much more energy than corresponding spectra for an ideal site.

30636 (STEV-VIND—84-7) **Flow characteristics above a very low and gently sloping hill.** Smedman, A.S.; Bergstroem, H. (Statens Energiverk, Stockholm (Sweden)). 1984. 26p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85750820.

Tower measurements of wind and turbulence in near neutral conditions at the top of a very low and gently sloping hill (height ca 20 m, with a length scale ca 1000 m) are analysed in terms of current flow over hill theory. Measurements of wind maximum height and the change of the variances of the three wind components from the inner to the outer region are found to be in agreement with predictions from the theory. Spectra of the longitudinal and vertical wind components in the inner region, come close to the corresponding Kansas curves in the high frequency range. They have higher energy in the low frequency region, probably a spectral lag effect caused by rougher upwind terrain. In the outer region the spectra coincide with the" corresponding Kansas curves if normalized by their respective variances and plotted against frequency ratio.

30637 **(STEV-VIND—84-8) Some observations of turbulence structure near a wooded coast line.** Smedman, A.S. (Statens Energiverk, Stockholm (Sweden)). 1983. 21p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85750821.

At the wind energy test site Kalkugnen, in Sweden, profile measurements together with turbulence measurement have been carried out during three years. The site is situated in complex terrain. The ground is sloping and the surface roughness varies between sea surface - rough open country - dense pine wood. In spite of this complexity an attempt is made to analyse wind profiles and velocity spectra in terms of a combination of flow over hill theory and flow over changing roughness.

30638 **(STEV-VIND—84-9) Sequential switching of a three-phase asynchronous wind generator onto the grid.** Zweygbergk, S. von. (Statens Energiverk, Stockholm (Sweden)). Dec 1983. 21p. (In Swedish). NTIS (US Sales Only), PC A02/MF A01. File Number DE85750822.

It has been shown that it could be possible to reduce the current of switching-on from 11.5 units to 4.5. The electrodynamic moment is also reduced. The calculation has been performed by means of Laplace Transformation.

30639 **(STEV-VIND—84-10) Investigation of the characteristics of the autosynchronous generator as a wind generator.** Briozzo, C.; Gutierrez, R.; Zweygbergk, S. von. (Statens Energiverk, Stockholm (Sweden)). Dec 1983. 81p. (In Swedish). NTIS (US Sales Only), PC A05/MF A01. File Number DE85750823.

The autosynchronous motor is similar to the asynchronous motor with a slide ring and it functions as a synchronous motor when its rotor is fed by direct current. An autosynchronous generator can work synchronously at high wind densities. On heavy flaws the machine is switched over to asynchronous mode. Three types of rotor circuits have been investigated, namely the Y-type, the conventional V-type and a V-type with damping. The extracted power was 75 percent to 85 percent of the labelled power. Calculations show that the transition from synchronous to asynchronous operation does not stress the rotor circuits. V-type with damping will permit a somewhat higher power outlet.

30640 **(STEV-VIND—84-11) Preliminary analysis of turbulence measurements at Naesudden during October 1980 and October 1982.** Hoegstroem, U. (Statens Energiverk, Stockholm (Sweden)). 1984. 29p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. File Number DE85750824.

Turbulence measurements and wind measurements performed during two autumn campaigns in 1980 and 1982 at the Naesudden peninsula WECS site have been analysed. The turbulence measurements have been taken at three levels in the 145 m mast: 11 m, 77 m and 134 m. To a large extent near neutral stratification prevailed in both measurement campaigns. Because of this the influence of terrain inhomogeniety (i.e. the presence of an extended wooded area at 1 to 2 km distance in one direction and of surrounding water areas at a similar distance for a large sector) on turbulence and can be studied in some detail. It is found that entirely undisturbed conditions prevail only for a rather narrow sector of northerly winds. For winds from most other sectors studied a moderate influence of terrain inhomogeniety is noticed in the studied turbulence quantities at 77 and 134 m. Highly anomalous conditions are found during an extended period (the measurement covered two days) in 1980 when the wind reaching the peninsula had an undisturbed over water fetch of several hundred kilometers: The wind profile was characterized by a maximum at 75-100 m above the surface. This feature was temporarily destroyed for a period of several hours when the wind turned less than 30 degrees to a direction where the flow had to pass a narrow strip of la (a few kilometers). The possible mechanism for this low level jet is discussed. It is suggested that frictional decoupling at the upwind coastline (some hundred kilometers away) may cause an inertial oscillation. It is, however, not clear at this stage whether such a phenomenon can survive travel for several hours in neutrally stratified air as prevailed in this stage.

30641 **(STEV-VIND—84-12) Turbulent characteristics of a shallow convective internal boundary layer.** Smedman, A.S.; Hoegstroem, U. (Statens Energiverk, Stockholm (Sweden)). 1984. 19p. Statens Energiverk, Stockholm, Sweden. File Number TI85750825.

Published in Boundary-Layer Meteorology. 25:271-287.

Turbulent characteristics of a 50 to 100 m deep convective internal layer (I.B.L.) have been studied. The data were gathered at a flat coastal site (Naesudden on the island of Gotland, Sweden) during three consecutive days in May 1980 which were characterized by a steady, very stable stratified marine approach flow. The site is situated on a flat area ca. 1500 m from the shoreline. Only daytime runs have been analysed in the present paper. The sensible heat flux at the ground was typically 200 W m^{-2} and was found to decrease more or less linearly with throughout the I.B.L., being slightly negative at greater height. The momentum flux was also found to decrease with height, but nevertheless shear production of turbulent kinetic energy was found to be large throughout the entire I.B.L. The analyses shows that the turbulent regime has a mixed character. Certain characteristics, such as the rate of growth of the I.B.L., appear to be almost entirely controlled by mechanical turbulence. Other turbulent characteristics, such as spectra of the horizontel wind components measured near the top of the I.B.L. tend to adhere to mixed-layer scaling in the high frequency range, exhiting much increased energy in the lower (reduced) frequency range.

30642 **(STEV-VIND—84-13) Case study of a boundary layer wind regime in stably stratified air over the Baltic Sea.** Hoegstroem, U.; Alexandersson, H.; Bergstroem, H. (Statens Energiverk, Stockholm (Sweden)). 1984. 31p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85750826.

Detailed boundary layer measuements from a coastal site on the island of Gotland in the Baltic Sea carried out during a two-day period in spring 1980 characterized by very steady south-easterly synoptic flow of a warm air mass over a much colder water surface have been analysed. It is suggested that the very complex wind hodographs can be explained in terms of the combined action or two independent processes: a corner effect, causing a strong anticlockwise turning and increase of the wind during the late afternoon and the early night hours, and frictional decoupling at the Latvian coast zone, ca. 200 km upwind of the measurement site, causing a pronounced low level jet during late night and early morning hours ca. 200 m above ground. It is also suggested that this type of low level jet brought by frictional decoupling at a coast line might be a rather common phenomenon over the sea at some distance from the coast line itself.

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REFER ALSO TO CITATION(S) 32105

30643 **(EPRI-EL—3983) Soil resistivity tests using modeling techniques. Final report.** Kasten, D.G.; Caldecott, R.; Mokhtarzadeh, A.; Minkara, S.; Chen, C. (Ohio State Univ., Columbus (USA). Dept. of Electrical Engineering). May 1985. 107p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920642.

Models of soil structure, used in the design of safe grounding grids for utility substations, require accurate information on the soil resistivity at the site. Small-scale tests on earth models in an electrolytic tank show that current field methods of measuring soil resistivity can provide the data needed to generate reliable models.

2001 Power Plants And Power Generation

REFER ALSO TO CITATION(S) 29720, 29722, 30198, 30766, 31828

30644 **(DOE/PC/70723—T2) Efficient power generation from high sulfur coal. Quarterly progress report for quarter ending March 31, 1985.** Knoke, G.S. (Flow Industries, Inc., Kent, WA (USA)). 17 May 1985. Contract FG22-84PC70723. 5p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85011920.

A numerical model of the coal-acid power plant cycle has been developed to allow sensitivity studies and preliminary optimization of the cycle. A numerical model has been prepared for each process step. The computer code has been designed to allow some flexibility for the process steps, both in terms of operating parameters and the selection of the process steps. An executive program is used to read the process definition file and to call subroutines which model individual process steps. A process stream is carried from step to step, and ancillary streams, heat flows, and power requirements are calculated. The process stream parameters are updated as appropriate after each process step.

30645 **(EPRI-CS—3844) Condenser procurement guidelines. Final report.** Impagliazzo, A.M. (Heat Transfer Consultants, Inc., Hingham, MA (USA)). May 1985. 123p. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303. File Number TI85920622.

Steam surface condensers have a major impact on power plant availability and efficiency. Since supplying condensers to the utility industry is a very competitive buisness, it is essential that all of the requirements, all of the operating and design conditions, and any off standard conditions which can affect the condenser design and performance be clearly communicated to potential suppliers. These requirements are officially transmitted via the Purchase Specification. This report is intended to provide guidance in the preparation of this document so that it will include all of the information needed by a competent specialist to design a condenser which will achieve the required performance in a reliable manner with minimum maintenance. A further objective is to provide guidelines which will permit the Purchaser to evaluate the diverse offerings of the various suppliers.

30646 **(EPRI-CS—3999-CCM-Vol.1) FEATURE: Finite-Element Analysis Tool for Utility Rotordynamic Evaluation. Volume 1. User's manual.** Lee, C.C.; Tecza, J.; Zorzi, E.S. (Mechanical Technology, Inc., Latham, NY (USA)). May 1985. 372p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920598.

The FEATURE computer program (an acronym for Finite-Element Analysis Tool for Utility Rotordynamic Evaluation) is a flexible, user-oriented tool for analysis of rotor-bearing systems. The program performs linear critical speed, damped response, and stability calculations for a wide range of rotor geometries, including multiple, concentric, counterrotating spools and large, multispan, rigidly coupled rotors. A finite-element formulation gives the program excellent numerical stability and the use of static substructuring greatly reduces run time.

30647 **(EPRI-CS—3999-CCM-Vol.2) FEATURE: Finite-Element Analysis Tool for Utility Rotordynamic Evaluation. Volume 2. FEATURE/COJOUR workshop notes.** Lee, C.C.; Tecza, J.; Zorzi, E.S. (Mechanical Technology, Inc., Latham, NY (USA)). May 1985. 328p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920645.

The FEATURE computer program (Finite-Element Analysis Tool for Utility Rotordynamic Evaluation) is a flexible, user-oriented tool for analysis of rotor-bearing systems. The program performs linear critical speed, damped response, and stability calculations for a wide range of rotor geometries, including multiple, concentric, counterrotating spools and large, multispan, rigidly coupled rotors. A finite-element formulation gives the program excellent numerical stability and the use of static substructuring greatly reduces run time. The COJOUR computer program is to provide a technically sound means for determining dynamic coefficients for use in the FEATURE code. It is capable of solving a wide variety of fluid film journal bearing configuration including both fixed-pad and tiling-pad types with or without thermal effects. The program will give comprehensive output such as load capacity, power loss, stiffness and dampling coefficients, etc.

30648 **(EPRI-CS—4014) 1983 fossil plant heat rate improvement workshop: proceedings.** Brown, R.G.; Quilliam, J.F.; Tome, A.E. (eds.). (Delian Corp., San Jose, CA (USA)). May 1985. 476p. (CONF-8309342—). Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920636.

From Fossil plant heat rate improvement workshop; St. Louis, MO, USA (20 Sep 1983).

An APRI sponsored workshop to address heat rate improvement of existing Fossil plants was hosted by Union Electric Company in Saint Louis, Missouri on September 20-22, 1983. This workshop was organized to provide a forum for representatives from several utilities to meet and address current key technical issues and problems associated with heat rate improvement. Another objective of this workshop was to provide utility input to EPRI project 1403-3, "Heat Rate Improvement of Existing Fossil Plants." The purpose of this project is to develop guidelines for utilities on the initiation and development of a heat rate improvement program. The workshop was attended by approximately 150 utility members representing 70 US and Canadian utilities. Formal presentations were given on several key topics of interest to utility personnel on heat rate improvement. Case studies describing important or unique utility experiences were presented. A presentation on EPRI research project 1403-3 discussed this project's objectives and provided a status report on the project activities. Copies of these papers are included in these proceedings. Working group discussion sessions were held on selected topics relevant to heat rate improvement to provide an opportunity for utility engineers to exchange ideas and information in a less formal environment. Summaries of these working group discussions are provided in these proceedings. In addition to the formal presentations and working group discussions, tutorials were given by recognized experts on topics of general interest and importance to utility engineers. Papers have been entered individually into EDB and ERA. (LTN)

30649 **(EPRI-EL—3918) Workshop proceedings: metering-type coupling capacitor voltage transformers (CCVTs).** (National Bureau of Standards, Washington, DC (USA)). Apr 1985. 290p. (CONF-8306269—). Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920603.

From Workshop on metering-type coupling capacitor voltage transformers (CCVTs); Gaithersburg, MD, USA (2 Jun 1983).

In the early 1970's there was a lot of concern in the utility industry over the reliability of coupling capacitor voltage transformers (CVVTs) for energy metering purposes. Because of this concern, a joint NBS-EPRI project was initiated in 1973 to develop a system that could be used to calibrate the CCVTs in situ. This work was completed in 1975. After that, NBS has used the system to perform calibrations upon request from utilities. A small data base related to CCVT performance has been collected by NBS but the data base is too small to allow any conclusions to be drawn about the reliability of CCVTs in general. A workshop involving people with experience in the design, manufacturing and usage of CCVTs was therefore organized by NBS and EPRI. This report covers the prepared presentations of the workshop participants and contains a record of the discussions taking place of the workshop.

30650 **(EPRI-NP—4056) Stress corrosion cracking in steam turbine disks: analysis of field and laboratory data. Final report.** Eason, E.D. (Failure Analysis Associates, Palo Alto, CA (USA)). May 1985. 94p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920660.

The field data and related laboratory data from many investigators were analyzed to identify the key variables and quantify their effects on stress corrosion cracking of turbine disks. Beginning with over 35 potential variables, pattern recognition and transformation analysis techniques were used to find and characterize the most important variables. The transformation analysis technique was also used to identify laboratory environments that are comparable to the field and to check for lab-to-lab differences in measured crack growth rate. Field data were also analyzed separately, using transformation analysis and order statistics to determine the effects of variables and produce statistical distributions of crack growth rate and failure rate with time. Models were constructed for the field and laboratory data to combine data from many sources and test conditions and to quantify the key variable effects. Two, three, and four variable models were calibrated to the available data. The four variable model is capable of correlating stress corrosion data for 19 low alloy steels with negligible increase in scatter compared to NiCrMoV data. The three variable model describes the behavior of disk steels in the field and comparable laboratory environments. 42 refs., 39 figs., 10 tabs.

30651 (EPRI-NP—4074M) Stress corrosion cracking and corrosion fatigue of steam turbine materials. Macdonald, D.D.; Szklarska-Smialowska, Z.; Moccari, A. (Ohio State Univ., Columbus (USA)). May 1985. 20p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920661.

A comprehensive study is reported on the stress corrosion cracking and corrosion fatigue behavior of Type 403SS turbine blade alloy and ASTM A-471 turbine disk steel in simulated low pressure steam turbine environments. The studies have been carried out using temperature, electrolyte type and concentration, loading wave form, R-ratio, potential, and metallurgical state of the steel as the principal experimental variables, with the ultimate goal in mind of identifying various mechanisms for crack propagation. Extensive electrochemical polarization studies are also reported and the results of this work have been used to characterize the corrosion and electrochemical state of any given alloy in an environment of interest. Some work is also reported on identifying potential inhibitors of stress corrosion cracking and corrosion fatigue in these steels in simulated low pressure steam turbine environments. A number of effective inhibitors have been identified. Finally, hydrogen permeation and trapping studies on ASTM A-471 were carried out to determine whether or not this steel is susceptible to hydrogen embrittlement or hydrogen-assisted crack propagation. These studies show that at ambient temperature, and to a lesser extent at elevated temperature (90°C), ASTM A-471 is susceptible to hydrogen-induced crack propagation in simulated low pressure steam turbine environments. 12 refs.

30652 (EUR—9271-DE) Utilization of industrial waste heat by ORC systems. Huppmann, G.; Weichselgartner, J.; Schmidt, G.; Dure, G.; Oechslein, W.; Raasch, E. (Commission of the European Communities, Luxembourg. Directorate-General for Information, Market and Innovation). 1984. 521p. (In German). Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities.

In this project the feasibility of the Organic Rankine Cycle Principle for waste heat recovery was investigated with an - in general - positive result. First of all the potential of waste heat in industry usable by ORCS was evaluated and the typical properties of ORCS usable heat sources were defined. In the second step we collected data about the working fluids, the expansion engines and the other components of a Rankine cycle. These data are presented in the final report so that potential users can design an ORCS for their heat sources, can evaluate the investment costs, the pay-back period and the rentability of his plant. A cost sensitivity study is given for seven ORC-plants differing in the temperature level, the working fluid, the efficiency and the energy recovering rate. The investment costs, the time of amortization and the rentability are compared. We projected ORC-plants for three typical applications in a few power output categories and evaluated the investment costs, the payback-periods and the rentabilities. The main result is that the less sophisticated plants get a higher benefit than plants with a high energetical efficiency. The results of our test programme are as follows: Screw expanders are usable up to about 100 kW for R114 with 5% lubricant; For higher temperatures turbines in connection with toluene get advantages, because the consequent separation between working fluid loop and lubricant loop is possible and for performances higher than 100 kW turbines for R114 and toluene are recommended.

30653 (FCR—6846) Advanced converter technology. Final report, May 23, 1979-December 31, 1984. Walton, J.W. (United Technologies Corp., South Windsor, CT (USA). Power Systems Div.). 1984. Contract AC01-79ET29079. 240p. NTIS, PC A11/MF A01; 1; GPO Dep. File Number DE85012502.

This report summarizes the results of a five year program to define an advanced power conditioner employing 1980's technology for use with multi-megawatt direct current power sources such as fuel cells, solar photovoltaics, and load-leveling batteries. The objective of this program is to define a multi-megawatt, grid-connected power conditioner which incorporates advanced components and systems technology to provide reduced cost and increased efficiency, reliability, and application flexibility. This overall objective is accomplished through the investigation of advanced power conditioner concepts, preparation of a preliminary design, and experimental verification of critical technical and operating features. The main emphasis is placed on power conditioners in the 5 to 10 MW range; a study of systems in the 0.5 to 5 MW range for use with solar photovoltaic sources is included. The major experimental efforts are: construction of a breadboard version of the logic and controls system; verification of the controls in converter system; and, construction and test of a 1.2-MW powerpole. The investigation is divided into the following categories: advanced system definition, improved switching circuits, improved magnetics, improved logic and controls, controls and system design confirmation, broader operating capability, interface definition and optimization, and solar application.

30654 (NP—5770191) Technological development and its impact on the future energy system. Appendix 1. Evaluation commissioned by the Danish Ministry of Energy. (Risoe National Lab., Roskilde (Denmark)). Jan 1984. 365p. (In Danish). NTIS (US Sales Only), PC A16/MF A01. File Number DE85770191.

Abstracts for each paper were entered into the data base. (MOW)

30655 (PB—85-157675/XAB) Effective use of cooling lakes and cooling towers in hybrid cooling systems. Completion report, July 1983-August 1984. Sturm, T.W. (Georgia Inst. of Tech., Atlanta (USA). Environmental Resources Center). Aug 1984. 73p. (ERC—07-84). NTIS, PC A04/MF A01.

Prepared in cooperation with Georgia Inst. of Tech., Atlanta. School of Civil Engineering.

The research summarized in this report analyzes the consequences of the use of hybrid cooling systems for the dissipation of waste heat from thermoelectric power generation. The hybrid cooling system study consists of a combination of cooling towers and a cooling lake to receive a specified heat load. A transient computer simulation model of both the cooling lake stratification and the cooling tower thermodynamic performance is developed. The model is calibrated and verified with field data. Simulations of various combinations of cooling lake and cooling tower capacities for a given power plant heat load are conducted to determine the effect on lake thermal structure, total water loss by evaporation, and power plant intake temperatures.

30656 The role of MHD in the energy future. Dicks, J.B.; Bart, A.J.; Crawford, L.W. (University of Tennessee Space Institute, Tullahoma, TN). *Proceedings, Intersociety Energy Conversion Engineering Conference;* 3: 1453-1462(Aug 1984). (CONF-840804—).

From Intersociety energy conversion engineering conference; San Francisco, CA, USA (19 Aug 1984).

This paper examines past MHD economic studies and compares results with current, more thorough, analyses using present value calculations. There is substantial agreement on cost per KWH within the range of options analyzed. More sophisticated financial analyses tools are used. A plant, in which the MHD process is combined with a downstream process producing synthetic fuel, is analyzed and compared with standard plants. The hybrid plant appears to have substantial economic advantages. MHD can probably produce electric power at 15 to 20 percent below conventional coal plants and competes well with advanced designed coal plants.

30657 (DOE-tr—273-Vol.1, pp IA1.1-IA1.8) **Results from comparative analysis of different magnetohydrodynamic generator and power train designs for early commercial power plant applications.** Hals, F.A.; Pian, C.C.P.; Sadovnik, I.; Stankevics, J.O. (Avco Everett Research Laboratory, Inc.). 1983. Translation source information not available . NTIS, PC A19/MF A01. Contract AC22-80ET15614.

From 8. international conference on MHD electrical power generation; Moscow, USSR (12 Sep 1983).

In Eighth International Conference on MHD Electrical Power Generation. Vol. 1.

This paper presents results from analyses of magnetohydrodynamic (MGD) power trains for commercial power plant applications. The analyses conducted were part of the first phase of a planned three phase program for the formulation of a Magnetohydrodynamic Advanced Power Train (APT) Development Program. Supersonic MHD generator channel operation at a peak magnetic field strength of 4.5 Tesla is attractive for early commercial MHD power generation. It offers substantial cost, saving and less risks for the magnet compared to subsonic channel operation at a peak magnetic field of 6 Tesla. The penalty in performance is relatively small and in the order of 10 to 15% less net MHD power produced or 0.5 to 1.0 percentage point less net overall plant efficiency. The part load performance characteristics of supersonic MHD generators are also attractive. Subsonic MHD generator channel operation at a higher field strength of 6 Tesla becomes more attractive as fuel cost increases because of its better performance and higher resulting net plant efficiency and as experience is gained with the construction and operation of large, high field strength MHD superconducting magnets. 11 refs., 2 figs., 5 tabs.

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REFER ALSO TO CITATION(S) 29672, 29674, 29675

30658 (DOE/EIS—0050-DS(79)) **Draft supplement, final environmental impact statement. Bonneville Power Administration proposed fiscal year 1979 program: facility location supplement, southwest Oregon area service, Buckely-Summer Lake 500 kV line.** (USDOE, Washington, DC). Oct 1979. 66p. NTIS, PC A04/MF A01; GPO Dep. File Number DE85008841.

This document assesses the environmental impacts of the proposed 156-mile Buckley-Summer Lake 500-kV transmission line; the proposed Buckley Substation near Maupin, Oregon; and the proposed Summer Lake Substation near Silver Lake, Oregon.

30659 (PB—85-156271/XAB) **Evaluation of rural air-quality simulation models. Appendix g. Statistical tables for PPSP (Power Plant Siting Program).** Londergan, R.; Minott, D.; Wackter, D.; Kincaid, T.; Bonitata, D. (TRC Environmental Consultants, Inc., East Hartford, CT (USA)). Oct 1982. 36p. NTIS, PC A03/MF A01.

See also PB83-182758.

This report summarizes the results of a comprehensive evaluation of rural point-source air-quality simulation models using routinely collected data around the Clifty Creek power plant. The report contains numerous tabulations of each model's performance in terms of statistical measures of performance recommended by the American Meteorological Society. The purpose of the report is two-fold. First, it serves to document for the models considered, and similar models, their relative performance. Second, it provides the basis for a peer scientific review of the models. To stay within the spirit of this latter purpose, the report is limited to a factual presentation of information and performance statistics. No attempt is made to interpret the statistics or to provide direction to the reader, lest reviewers might be biased.

30660 (PB—85-173086/XAB) **Western Maryland power plant siting study: air-quality assessment of three candidate sites. Final report.** Weil, J.C.; Pierce, T.E.; Corio, L.A. (Martin Marietta Environmental Systems, Columbia, MD (USA)). Jan 1985. 119p. NTIS, PC A06/MF A01.

Prepared in cooperation with Martin Marietta Labs., Baltimore, MD. ;See also PB85-172948.

This report presents the detailed analyses of air-quality impacts related to three candidate sites under consideration in the Western Maryland Power Plant Siting Study. Both EPA-approved and state-of-the-art dispersion models were used to evaluate ground-level concentrations against NAAQS and PSD Class II limits for both flat and elevated terrain areas. Candidate areas are described and stack and fugitive emissions and plant operating parameters are provided. Local meteorological data are used to predict ground-level concentrations for primary stack pollutants, fugitive dust, and fluoride levels. Visibility degradation and cooling-tower moisture effects are also evaluated. PSD Class II limits for SO_2 could be met at all candidate sites based on state-of-the-art modeling. EPA-approved models indicate that both Washington County options could realize greater potential emissions than the Frederick County option. No difference is anticipated in visible cooling-tower plume frequency, salt deposition, or enhanced icing.

30661 (PB—85-173276/XAB) **Western Maryland power plant siting study: biological characterization of candidate sites. Final assessment. Final report.** Jacobs, F.; Himel, J.; Cummins, R.; Weisberg, S. (Martin Marietta Environmental Systems, Columbia, MD (USA)). Oct 1984. 181p. NTIS, PC A09.

See also PB85-173516; Portions of this document are not fully legible.

Three locations in western Maryland are being considered as potential candidate sites for future construction of a 1200-1800 MWe coal-fired power plant. This report provides a detailed biological characterization of each site and assesses potential terrestrial and aquatic impacts associated with plant construction and operation. This assessment considers possible impacts on geomorphology, vegetation, wildlife, water quality, and nearby aquatic biota. Relevant information contained in a Phase I document produced earlier under this contract, was incorporated into this final report.

30662 (PB—85-173482/XAB) **Western Maryland power-plant siting study: socio-economic impact assessment of three candidate sites. Final report.** (Urban Systems Research and Engineering, Inc., Washington, DC (USA)). Jan 1985. 189p. NTIS, PC A09/MF A01.

See also PB85-174779.

This report summarizes the socio-economic impacts that are expected to arise from the construction and operation of an 1890-MW conventional coal-fired power plant being evaluated at three candidate sites in Western Maryland. Three scenarios are evaluated: simultaneous construction (no staging) of three 630-MW units, 2-year staging of three 630-MW units, and 4-year staging of three 630-MW units. Economic profiles of Washington and Frederick counties, MD, are summarized in detail, and the related economic links with surrounding MD, PA, WV, and VA counties are described. Employment, income, population, housing, tax revenue, and government-expenditure impacts are summarized. Public service costs and transportation, land use, and visual-quality issues are also summarized. Traffic congestion is anticipated to be mostly felt close to the sites and is of a relatively short duration.

30663 (PB—85-173912/XAB) **Flue-gas conditioning. Final report, March 1979-March 1982.** Yung, S.C.; Patterson, R.G.; Hancock, B.L.; Calvert, S. (Air Pollution Technology, Inc., San Diego, CA (USA)). Feb 1985. 110p. NTIS, PC A06/MF A01.

The report gives results of a survey of available flue-gas conditioning agents and user experience. Many existing chemicals have been used as conditioning agents in power plants or have been studied in the laboratory as potential agents. The particle-collection efficiency of an electrostatic precipitator (ESP) for coal-fired power plant flue-gas cleaning depends on the electrical properties of the fly ash, among other things. Flue-gas conditioning refers to the addition of chemicals to the flue gas for modification of fly-ash properties and/or electrical conditions in the ESP to improve the collection efficiency of ESPs. Conditioning is usually used to upgrade existing ESPs.

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REFER ALSO TO CITATION(S) 30143, 30178, 30649, 30658, 32111

30664 **(EPRI-EL—3974) Development of molded joints and terminals for 230-kV extruded cross-linked polyethylene (XLPE) insulated cable. Final report.** Bahder, G.; Bopp, L.A.; Eager, G.S. Jr.; Katz, C.; Knott, A.; Schmidt, G.A. (General Cable Co., Edison, NJ (USA)). Apr 1985. 32p. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303. File Number TI85920608.

The reliability of extruded-dielectric transmission systems depends to a great extent on the quality of joints and terminals. Detailed procedures developed in this study for field-molding high-stress 230-kV cable joints can ensure the stability of critical interfaces over many years.

30665 **(EPRI-EL—3977-Vol.1) Calculating ac/dc resistance ratios for high-pressure oil-filled cable Designs. Volume 1. Designer's guide. Final report.** Sosnowski, M.; Bahder, G.; Mekjian, A. (Cable Technology Labs., Inc., New Brunswick, NJ (USA)). Apr 1985. 52p. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303. File Number TI85920602.

Using electromatic field theory, a new method is developed for calculating alternating current in power cables installed in pipes of carbon steel (magnetic pipes). The technique for evaluating these losses is based on the method of images which replaces complicated distribution of currents in the system with a sequence of thin conductors. The method not only gives a mathematical framework for the solution of alternating current losses, but it also gives the underlying physical picture of effects contributing to these losses. Skin effect, proximity effect and losses due to the pipe are calculated separately. For the first time, the increase of losses in the conductors, when the cables are placed in a magetic pipe, are analyzed mathematically. Good agreement is obtained between the result of calculations and the experimentally determined ac-dc resistance ratios for pipe-type cables with concentric stranded copper conductors and also for cables with aluminum or copper segmental conductors when appropriate factors modifying conductor resistance to account for the effect of segmenting are introduced. Volume 1 of the report is the designer's guide containing all the formulas and tables necessary for performing the calculations while Volume 2 presents the theoretical background of the method.

30666 (NP—5770191, pp 3.1-3.29) **Power supply system. Some factors affecting the future production pattern.** Jan 1984. (In Danish). NTIS (US Sales Only), PC A16/MF A01.

EFP-81.

In Technological development and its impact on the future energy system. Appendix 1. Evaluation commissioned by the Danish Ministry of Energy.

The Danish electric power production is nowadays based on fossil fuel power plants. The future sources comprehend nuclear power and wind power, their contribution probably insignificant until the next century. Future technological problems of load control, long-distance power transmission and development of storage facilities for heat and electricity are briefly reviewed.

30667 **(SAND—84-2458C) Injector losses on Mite.** Woodall, H.N.; Stinnett, R.W. (Sandia National Labs., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 16p. (CONF-850616—4). NTIS, PC A02/MF A01; GPO Dep. File Number DE85012356.

From 5. IEEE pulsed power conference; Washington, DC, USA (10 Jun 1985).

One of the most critical areas in a magnetically-insulated power feed is the injector section. In this portion of the feed, the electric field at the cathode becomes sufficient to cause cathode plasma formation and electron flow in the gap. We have used Faraday cups and filtered 4-chlorostyrene monitors to measure losses in this initial portion of the Mite (2 MV, 4.8 ohm) magnetically-insulated transmission line. Electron losses in the injector are measurable and last through most of the pulse. The propagation of the magnetic insulation wave through the injector region is slower in the injector region (~.4c) than in the rest of the line (~.6c). These experiments were performed using both carbon-coated and bead-blasted aluminum surfaces.

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REFER ALSO TO CITATION(S) 31430, 31795

30668 **(CEA-CONF—7539) Simulators as safety analysis tool.** Peltier, J. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete). Mar 1984. 21p. (In French). (CONF-8403181—1; DAS—81). NTIS (US Sales Only), PC A02/MF A01. File Number DE85751318.

From SFEN conference on simulator part in nuclear safety; Paris, France (20 Mar 1984).

This report shows the interest of a simulator in the safety analysis of a nuclear reactor. The SALAMANDRE simulator of the Institut de Protection et de surete Nucleaire (IPSN, Fontenay-aux-Roses, (France)) is presented very briefly.

30669 **(NUREG—0020-Vol.9-No.4) Licensed operating reactors. Status summary report, data as of March 31, 1985. Volume 9, No. 4 .** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Resource Management). Apr 1985. 450p. NTIS, PC A19/MF A01 - GPO. File Number TI85901532.

This report provides data on the operation of nuclear units as timely and accurately as possible. This information is collected by the Office of Resource Management, from the Headquarters' Staff of NRC's Office of Inspection and Enforcement, from NRC's Regional Offices, and from utilities. Since all of the data concerning operation of the units is provided by the utility operators less than two weeks after the end of the month, necessary corrections to published information are shown on the ERRATA page. This report is divided into three sections: the first contains monthly highlights and statistics for commercial operating units, and errata from previously reported data; the second is a compilation of detailed information on each unit, provided by NRC Regional Offices, IE Headquarters and the Utilities; and the third section is an appendix for miscellaneous information such as spent fuel storage capability, reactor years of experience and non-power reactors in the United States.

2101 Power Reactors, Non-breeding, Light-water Moderated, Boiling Water Cooled

REFER ALSO TO CITATION(S) 29899, 29924, 30043, 30691, 30700, 30703, 30705, 30706, 30707, 30712, 30755, 30757, 30760, 30761, 30765, 30827, 30832, 30833, 30845, 30846, 30861, 30864, 30881, 30882, 30885, 30886, 30895, 30897, 30900, 30913, 30922, 30923, 30932, 30933, 30936, 30938, 30957, 30961, 30966, 30984, 30985, 30987, 30989, 30990, 30991, 30992, 30994, 30995, 30996, 30997, 30998, 30999, 31000, 31001, 31002, 31003, 31004, 31006, 31007, 31008, 31011, 31012, 31015, 31018, 31019, 31020, 31022, 31025, 31028, 31030, 31031, 31032, 31033, 31035, 31040

30670 **(BNL-NUREG—36144) Decontamination impacts on solidification.** Piciulo, P.L.; Davis, M.S. (Brookhaven National Lab., Upton, NY (USA)). 1985. Contract AC02-76CH00016. 17p. (CONF-850279—1). NTIS, PC A02/MF A01 - GPO. File Number TI85010545.

From Chemical decontamination on boiling water reactors; Charlotte, NC, USA (26 Feb 1985).

The increased occupational exposure resulting from the accumulation of activated corrosion products in the primary system of LWRs has led to the development of chemical methods to remove the contamination. In the past, the problem of enhanced migration of radionuclides away from trenches used to dispose of low-level radioactive waste, has been linked to the presence, at the disposal unit, of chelating or complexing agents such as those used in decontamination processes. These agents have further been found to reduce the normal sorptive capacity of soils for radionuclides. The degree to which these agents inhibit the normal sorptive processes is dependent on the type of complexing agent, the radionuclide of concern, the soil properties and whether the nuclide is present as a complex or is already sorbed to the soil. Since the quantity of reagent employed in a full system decontamination is large (200 to 25,000 kg), the potential for enhanced migration of radionuclides from a site used to dispose of the decontamination wastes should be addressed and guidelines established for the safe disposal of these wastes.

30671 **(DOE/ER/12075—4FR) Hydrodynamics of single- and two-phase flow in inclined rod arrays.** Todreas, N.E. (Massachusetts Inst. of Tech., Cambridge (USA)). 1984. Contract AC02-82ER12075. 416p. NTIS, PC A18/MF A01; 1; GPO Dep. File Number DE85012560.

Required inputs for thermal-hydraulic codes are constitutive relations for fluid-solid flow resistance, in single-phase flow, and interfacial momentum exchange (relative phase motion), in two-phase flow. An inclined rod array air-water experiment was constructed to study the hydrodynamics of multidimensional porous medium flow in rod arrays. Velocities, pressures, bubble distributions, and void fractions were measured in inline and rotational square rod arrays of P/d = 1.5, at 0, 30, 45, and 90 degree inclinations to the vertical flow direction. Constitutive models for single-phase flow resistance are reviewed, new comprehensive models developed, and an assessment with previously published and new data made. The principle of superimposing one-dimensional correlations proves successful for turbulent single-phase inclined flow. For bubbly two-phase yawed flow through incline rod arrays a new flow separation phenomena was observed and modeled. Bubbles of diameters significantly smaller than the rod diameter travel along the rod axis, while larger diameter bubbles move through the rod array gaps. The outcome is a flow separation not predictable with current interfacial momentum exchange models. This phenomenon was not observed in rotated square rod arrays. Current interfacial momentum exchange models were confirmed for this rod arrangement. Models for the two phase flow resistance multiplier for cross flow were reviewed and compared with data from cross and yawed flow rod arrays. Both drag and lift components of the multiplier were well predicted by the homogenous model. Other models reviewed overpredicted the data by a factor of two.

30672 **(DOE/ET/34031—18) BWR Fuel Bundle Extended Burnup Program. Final report.** Baumgartner, J.A. (comp.). (General Electric Co., San Jose, CA (USA). Nuclear Engineering Div.; Northern States Power Co., Minneapolis, MN (USA)). Dec 1984. Contract AC02-80ET34031. 98p. (GEAP—30846). NTIS (US Sales Only), PC A05/MF A01; 1; GPO Dep. File Number DE85009056.

This is the final report for the BWR Fuel Bundle Extended Burnup Program. The highest burnup fuel bundles in this program reached bundle averages of 45.6 GWd/MTU with measured peak pellet burnups of 58.7 GWd/MTU. Program results through 1983 are summarized, and the final Vallecitos Nuclear Center hot cell examination results are described in detail. The overall results obtained from thorough site examinations, and hot cell examinations and testing, confirm the good performance expectations at high burnup. Fuel bundles which are designed to adequately accommodate the differences in rod growth at high burnup will be capable of reliable operation to exposures at least as high as those attained in this program.

30673 **(DOE/NE/34130—1-Vol.1) Light water reactor fuel performance: proceedings. Volume 1.** (American Nuclear Society. Florida Section). Apr 1985. Contract AH01-85NE34130. 349p. (CONF-850401—Vol.1). NTIS (US Sales Only), PC A15/MF A01; 1; GPO Dep. File Number DE85010567.

From Topical meeting on light water reactor fuel performance; Orlando, FL, USA (21 Apr 1985).

Separate abstracts are presented for each of the papers concerning PWR type reactor and BWR type reactor fuel performance and the corrosion of Zircaloy fuel cans.

30674 **(DOE/NE/34130—1-Vol.2) Light water reactor fuel performance: proceedings. Volume 2.** (American Nuclear Society. Florida Section). Apr 1985. Contract AH01-85NE34130. 352p. (CONF-850401—Vol.2). NTIS (US Sales Only), PC A16/MF A01; 1; GPO Dep. File Number DE85011221.

From Topical meeting on light water reactor fuel performance; Orlando, FL, USA (21 Apr 1985).

Separate abstracts are presented for each of the papers presented concerning fission product behavior, burnable absorbers, ramping experience, and advanced fuel designs.

30675 **(DOE/OR/21400—T127) Light water reactor pressure vessel simulation (LWR-PVS) program.** Kam, F.B.K. (Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 53p. NTIS, PC A07/MF A01 - GPO. File Number TI85013046.

The LWR-PVS program has two major tasks; the first task is concerned primarily with well-defined reproducible benchmark experiments, and the second task deals with ASTM Standards activities. During this report period, the following work was accomplished: program documentation; Final Phase II and Preliminary Phase III calculations of the VENUS PWR Mockup Experiment; NESDIP transport calculations for the 0-cm, 20 cm, and 70-cm cavity configurations; Babcock & Wilcox (B & W) SDMF perturbation experiment; the fifth NRC HSST series of metallurgical irradiations; and ASTM standards activities.

30676 **(EGG-RST—6860) Technical evaluation report TMI action - NUREG-0737 (II.D.1) relief and safety valve testing for Clinton Power Station Unit 1. (Docket No. 50-461).** Burr, T.K.; Magleby, H.L. (EG and G Idaho, Inc., Idaho Falls (USA)). May 1985. Contract AC07-76ID01570. 19p. NTIS, PC A02/MF A01. File Number TI85012472.

Light water reactors operators have experienced a number of occurrences of improper performance by safety and relief valves installed in their primary coolant systems. Because of this, the authors of NUREG-0578 (TMI-2 Lessons Learned Task Force Status Report and Short-Term Recommendations) recommended that programs be developed and completed which would reevaluate the performance capabilities of BWR safety and relief valves. This report has examined the response of the Licensee for the Clinton Power Station, Unit 1 to the requirements of NUREG-0578 and subsequently NUREG-0737 and finds that the Licensee has provided an acceptable response, reconfirming that the General Design Criteria 14, 15 and 30 of Appendix A to 10 CFR-50 have been met.

30677 **(EPRI-NP—4010) Improvements to critical path time for BWR refueling outages. Final report.** Howard, N.C.; Johnson, K.R.; Kachel, P.F.; Karan, L.F.; Kowdley, B.S.; Patel, H.C.; Perry, D.R.; Punches, J.R.; Shira, M.L.; Stoll, B.G. (General Electric Co., San Jose, CA (USA). Nuclear Energy Business Operations). May 1985. 273p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920653.

A previous study performed by General Electric Company (GE), identified 23 improvements that could save critical path time during refueling outages in boiling water reactors (BWR). This program, sponsored by the Electric Power Research Institute (EPRI), developed 7 of the 23 improvements. These improvements are applicable to commercial BWR/2,3 and 4 nuclear power plants now in operation and in some cases those BWRs in the design and construction phase. Four of the recommended improvements can be implemented immediately by a utility without further technical development or plant unique modifications. Use of all improvements could reduce the fueling outage time by 7 days. This time savings represents an increase in plant availability, a significant cost savings in terms of replacement energy charges, and reductions in personnel radiation exposure. Each of the improvements are summarized.

30678 **(EPRI-NP—4032) Impact of colloidal chemistry on radioactivity transport in nuclear power plants.** Smith-Magowan, D. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Center). May 1985. 98p. Research Reports Center, Box 509490, Palo Alto, CA 94303. File Number TI85920656.

A broad overview of colloid chemistry research is presented which highlights fundamental concepts and application to corrosion and radioactivity transport in water reactor coolant circuits. The purpose of this overview is to provide a basis for judging the degree of applicability of colloidal research to radioactivity transport and for judging the most feasible approach for measuring relevant properties of colloids under conditions typical of reactor operation. The oxide/solution interface is shown to be an important element in the mechanism of corrosion and the physical and chemical characteristics of such interfaces that relate to radioactivity transport are discussed. The zeta potential is introduced as the most important single property for characterizing the oxide/solution interface and associated phenomena such as adsorption and electrokinetics. The nature of electrokinetic processes is discussed in detail, since these form the bases for methods generally adopted for study of the interfaces in question. A design for a flat plate device for measuring streaming potentials is presented and recommended as the most feasible method for determining zeta potentials of oxide/solution interfaces at the temperatures and pressures characteristic of reactor coolant environments. Possible results from such studies are discussed as well as the applicability or relevance of these results to controlling radioactivity transport. 126 refs., 20 figs.

30679 (IAEA-TC—427/5, pp 200-206) **Non-equilibrium effects in flashing liquids.** Egely, G. (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). Jul 1984. NTIS (US Sales Only), PC A14/MF A01. File Number TI. (CONF-8310369—; TC-SR—3).

From Specialists' meeting on experimental and modelling aspects of small-break LOCA; Budapest, Hungary (3 Oct 1983).

A two-fluid model is discussed, which is able to describe thermal and mechanical non-equilibrium, as well as some existing computational methods and the difficulties of modelling.

30680 (IAEA-TC—427/5, pp 207-215) **Prediction of critical flow of subcooled and saturated water and comparison with the Marviken full scale experiments.** Persson, P.; Flinta, J. (Nuclear Safety Board of the Swedish Utilities, Nykoeping (Sweden)). Jul 1984. NTIS (US Sales Only), PC A14/MF A01. File Number TI. (CONF-8310369—; TC-SR—3).

From Specialists' meeting on experimental and modelling aspects of small-break LOCA; Budapest, Hungary (3 Oct 1983).

A method developed for the prediction of critical flow of subcooled and saturated water is compared to the Marviken full scale experiments and some other relevant data. It is shown that this method gives better agreement with the data than other methods. Besides that, the method is relatively simple to use since its equations give the flow in an explicit form.

30681 (IAEA-TC—427/5) **Experimental and modelling aspects of small-break LOCA. Proceedings of a specialists' meeting organized by the IAEA and held in Budapest, Hungary, 3-7 October 1983.** (International Atomic Energy Agency, Vienna (Austria). Technical Committee on Thermal Reactor Safety Research). Jul 1984. 321p. (CONF-8310369—; TC-SR—3). NTIS (US Sales Only), PC A14/MF A01. File Number DE85781016.

From Specialists' meeting on experimental and modelling aspects of small-break LOCA; Budapest, Hungary (3 Oct 1983).

Separate abstracts were prepared for each included paper. (MOW)

30682 (IWGFPT—20, pp 46-63) **Remarks on the cycle length extension of BWR plants.** Prosperi, M.; Repossini, S. (AGIP Nucleare, Milan (Italy)); Felici, S. (Ente Nazionale per l'Energia Elettrica, Rome (Italy)). Dec 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85900589. (CONF-8405285—).

From IAEA improved utilization of water reactor fuel with special emphasis on extended burnups and plutonium recycling meeting; Mol, Belgium (7 May 1984).

The report underlines the interconnection between the bundle enrichment and the cycle length. A fuel cycle study on a BWR plant (with specific power of 55 KW/M, 560 fuel assemblies, control cell core loading and a fixed stretch-out of 1000 MWD/MTU) with the objectives of reaching the maximum cycle length is described. Relevant results, referring to an equilibrium cycle, can be summarized as follows: 1) The fulfillment of the 1% of shutdown margin and the preservation of the hot excess value above the 0.5%, for the entire cycle, required the use of 3 types of reload bundles. With such core loading the power distribution is satisfactory: using a non-optimized loading pattern, thermal performance parameters comparable or better than the ones attained with standard 12 months cycles were obtained. The cycle length (inclusive of the planned stretch-out of 1000 MWD/MTU) has reached 9750 MWD/MTU, the discharge batch BU has reached the value of 29,630 MWD/MTU. 2) The results infer that the adoption of the bundle design at high enrichments (with axially averaged enrichment of 3.5%): A) Can lead to a batch discharge BU of about 33,000 MWD/MTU, that is largely below the discharge limits. B) Can lead to a cycle length of about 10,800 MWD/MTU, which is closer to the value than most of the utilities estimate as optimal for a sound energy management.

30683 (IWGFPT—20, pp 64-70) **Optimized BWR fuel lattice for improved fuel utilization.** Bernander, O.; Helmersson, S.; Schoen, C.G. (ASEA-ATOM AB, Vaesteraas (Sweden)). Dec 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85900589. (CONF-8405285—).

From IAEA improved utilization of water reactor fuel with special emphasis on extended burnups and plutonium recycling meeting; Mol, Belgium (7 May 1984).

Optimization of the BWR fuel lattice has evolved into the water cross concept, termed "SVEA", whereby the improved moderation within bundles augments reactivity and thus improves fuel cycle economy. The novel design introduces into the assembly a cruciform and double-walled partition containing nonboiling water, thus forming four subchannels, each of which holds a 4x4 fuel rod bundle. In Scandinavian BWRs - for which commercial SVEA reloads are now scheduled - the reactivity gain is well exploited without adverse impact in other respects. In effect, the water cross design improves both mechanical and thermal-hydraulic performance. Increased average burnup is also promoted through achieving flatter local power distributions. The fuel utilization savings are in the order of 10%, depending on the basis of comparison, e.g. choice of discharge burnup and lattice type. This paper reviews the design considerations and the fuel utilization benefits of the water cross fuel for non-Scandinavian BWRs which have somewhat different core design parameters relative to ASEA-ATOM reactors. For one design proposal, comparisons are made with current standard 8x8 fuel rod bundles as well as with 9x9 type fuel in reactors with symmetric or asymmetric inter-assembly water gaps. The effect on reactivity coefficients and shutdown margin are estimated and an assessment is made of thermal-hydraulic properties. Consideration is also given to a novel and advantageous way of including mixed-oxide fuel in BWR reloads.

30684 (IWGFPT—20, pp 269-281) **Performance of the plutonium-island fuel assemblies loaded into the Dodewaard boiling water reactor.** Breemer, N.C.; Engen, W.R. van; Hulst, P.J. von den (Gemeenschappelijke Kernenergiecentrale Nederland N.V., Arnhem); Haas, D.; Outryve d'Ydewalle, B. van (Societe Belge pour l'Industrie Nucleaire, Brussels). Dec 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85900589. (CONF-8405285—).

From IAEA improved utilization of water reactor fuel with special emphasis on extended burnups and plutonium recycling meeting; Mol, Belgium (7 May 1984).

The 6x6 assemblies were designed to have the same performance as and to be interchangeable with a standard uranium assembly of the same reload. The assemblies were composed of 20 or 22 UO_2 pelletized rods at the bundle periphery, 1 MOX, a standard UO_2 or a fuelless grid support rod, 12 to 16 mixed oxide fuel rods and (in some assemblies) 2 Gadolinium doped UO_2 rods. Rods were pelletized, or vibro-compacted. Two MOX-assemblies were loaded into the reactor in April 1971 until April 1974 (cycles 2, 3, 4 and 5) and achieved an average bundle burnup of 20.2 GWd/tM. The assemblies appeared to have failed fuel rods (a standard UO_2-rod) at discharge, most probably developed during cycle 5. All MOX fuel rods remained entire. The remaining 5 assemblies were first loaded into the reactor in cycle 5 and 6 and remained there for 4 to 5 cycles. The maximum average bundle burnup achieved with these assemblies is 34.8 GWd/tM. The only leaking MOX-rod of these assemblies already occurred at the end of its first cycle in the reactor. Post-irradiation non-destructive tests contained: visual inspection, neutrography, gamma scanning, eddy current tests etc. Destructive PIE consisted of fuel rod punctures and gas analysis, residual gas analysis, hydrogen determination in the clad, metallographic examinations and microprobe analysis. The vibrocompacted fuel revealed a substantial higher central temperature than the pelletized fuel due to a different thermal conductivity.

30685 (NUREG—0975-Vol.3) **Compilation of contract research for the Materials Engineering Branch, Division of Engineering Technology. Annual report for FY 1984. Volume 3.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering Technology). Apr 1985. 398p. NTIS, PC A17/MF A01 - GPO. File Number TI85901503.

This compilation of annual reports by contractors to the Materials Engineering Branch of the NRC Office of Research, concentrates on achievments in safety research for the primary system of commercial light water power reactors, particularly with regard to reactor vessels, primary system piping, steam generators and for non-destructive examination of primary system components. This report, covering research conducted during Fiscal Year 1984, is the third volume of the series of NUREG-0975, compilation of Contractor Research for the Materials Engineering Branch, Division of Engineering Technology.

30686 (NUREG/CR—0200-Vol.3, pp vp, Section M6) **ORIGEN-S data libraries.** Ryman, J.C. (Oak Ridge National Lab., TN). Dec 1984. NTIS, PC A21/MF A01 - GPO. File Number TI85007581. (ORNL/NUREG/CSD—2/Vol.3).

In SCALE: a modular code system for performing standardized computer analyses for licensing evaluation. Volume 3. Miscellaneous.

There are five card-image nuclear data libraries: (1) a small light element library for 253 nuclides, (2) a large light element library for 687 nuclides, (3) an actinide library for 101 nuclides, (4) a small fission product library for 461 nuclides, and (5) a large fission product library for 821 nuclides. The data for each nuclide are contained on five card-image records. The first card image contains decay data (half-life, branching fractions, recoverable energy per decay and the fraction of recoverable energy from photons), percent natural abundance, and radioactivity concentration guides. The last four card images contain cross section and (for fission product nuclides) fission yield data for four reactor types (HTGR, LWR, LMFBR, and MSBR), with one card for each reactor type. The card-image nuclear data libraries are the basic libraries for ORIGEN-S. The code can be run using these libraries directly, or it can be run from a binary data library which (prior to any cross section or other nuclear data updating) was created by running the COUPLE code to convert one or more of these card-image libraries.

30687 (NUREG/CR—3863) **Assessment of Class 1E pressure transmitter response when subjected to harsh environment screening tests.** Furgal, D.T.; Craft, C.M.; Salazar, E.A. (Sandia National Labs., Albuquerque, NM (USA)). Mar 1985. Contract AC04-76DP00789. 196p. (SAND—84-1264). NTIS, PC A09/MF A01 - GPO. File Number TI85012824.

An experimental investigation into the performance of Class 1E electronic pressure transmitters exposed to environments within and beyond the design basis has been conducted. Emphasis was placed on determining the instruments' failure and degradation modes in separate and simultaneous environmental exposures. Five unaged ITT Barton Model 763 pressure transmitters were tested; each transmitter was exposed to a unique environment. The environments were (1) simulated Loss of Coolant Accident (LOCA) steam/chemical spray conditions alone, (2) temperature alone, (3) radiation alone, (4) simultaneous radiation and LOCA temperature (no steam) conditions, and (5) simultaneous radiation and simulated LOCA steam/chemical spray conditions. 23 refs., 33 figs., 8 tabs.

30688 (NUREG/CR—4086) **Tensile properties of irradiated nuclear grade pressure vessel welds for the third HSST irradiation series.** McGowan, J.J. (Oak Ridge National Lab., TN (USA)). Mar 1985. Contract AC05-84OR21400. 22p. (ORNL/TM—9477). NTIS, PC A02/MF A01 - GPO. File Number TI85009806.

The Heavy Section Steel Technology (HSST) Program conducted a series of experiments to investigate the effect of neutron irradiation on the fracture toughness of nuclear pressure vessel materials. Four welds of A 508 class 2 steel were examined in this Third HSST Irradiation Series. The welds were fabricated according to "early" (pre-1972) light-water reactor weld practice (i.e., copper-coated electrodes). As part of this study, tensile properties were measured after irradiation to 2 to 10 x 10^{22} neutrons/m^2 (E > 1 MeV) at temperatures between 250 and 290°C. Strength properties of all four welds increased with exposure to irradiation. Yield strength was more sensitive to irradiation than was ultimate strength. Tensile ductility was not affected significantly by exposure to irradiation.

30689 (NUREG/CR—4204) **Long-term embrittlement of cast duplex stainless steels in LWR systems. Annual report, October 1983-September 1984.** Chopra, O.K.; Chung, H.M. (Argonne National Lab., IL (USA)). Mar 1985. Contract W-31-109-ENG-38. 31p. (ANL—85-20). NTIS, PC A03/MF A01 - GPO. File Number TI85011158.

A program is being conducted to investigate the significance of in-service embrittlement of cast duplex stainless steels under light-water reactor operating conditions. The existing data are evaluated to determine the expected embrittlement of cast components during the operating lifetime of reactors and to define the objectives and scope of the investigation. Data for the metallurgical characterization of the various cast stainless steels used in the investigation are presented. Charpy impact tests on short-term aged material indicate that CF-3 stainless steels are less susceptible to embrittlement than CF-8 or CF-8M stainless steels. Embrittlement of the ferrite phase is primarily due to pinning of the dislocations by two of these precipitates, designed as Type M and Type X. The ferrite phase is embrittled after ~8 yr at 300°C and shows cleavage fracture. Examination of the fracture surfaces of the impact-test specimens indicates that the toughness of the long-term aged material is determined by the austenite phase. 5 refs., 7 figs., 6 tabs.

30690 (NUREG/CR—4221) **Evaluation of stress corrosion crack growth in BWR piping systems.** Kassir, M.; Sharma, S.; Reich, M.; Chang, M.T. (Brookhaven National Lab., Upton, NY (USA)). May 1985. Contract AC02-76CH00016. 77p. (BNL-NUREG—51874). NTIS, PC A05/MF A01 - GPO. File Number TI85012540.

This report presents the results of a study conducted to evaluate the effects of stress intensity factor and environment on the growth behavior of intergranular stress corrosion cracks in type 304 stainless steel piping systems. Most of the detected cracks are known to be circumferential in shape, and initially started at the inside surface in the heat affected zone near girth welds. These cracks grow both radially in-depth and circumferentially in length and, in extreme cases, may cause leakage in the installation. The propagation of the crack is essentially due to the influence of the following simultaneous factors: (1) the action of applied and residual stress; (2) sensitization of the base metal in the heat affected zone adjacent to girth weld; and (3) the continuous exposure of the material to an aggressive environment of high temperature water containing dissolved oxygen and some levels of impurities. Each of these factors and their effects on the piping systems is discussed in detail in the report. The report also evaluates the time required for hypothetical cracks in BWR pipes to propagate to their critical size. The pertinent times are computed and displayed graphically. Finally, parametric study is performed in order to assess the relative influence and sensitivity of the various input parameters (residual stress, crack growth law, diameter of pipe, initial size of defect, etc.) which have bearing on the growth behavior of the intergranular stress corrosion cracks in type 304 stainless steel. Cracks in large-diameter as well as in small-diameter pipes are considered and analyzed. 27 refs., 25 figs., 10 tabs.

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REFER ALSO TO CITATION(S) 29899, 29924, 30043, 30670, 30671, 30673, 30674, 30675, 30678, 30679, 30680, 30685, 30686, 30687, 30688, 30689, 30723, 30755, 30756, 30758, 30760, 30761, 30763, 30764, 30771, 30827, 30829, 30831, 30833, 30839, 30842, 30845, 30846, 30853, 30856, 30861, 30862, 30863, 30864, 30874, 30880, 30881, 30882, 30883, 30884, 30885, 30887, 30891, 30893, 30895, 30896, 30897, 30900, 30906, 30911, 30915, 30917, 30918, 30921, 30922, 30923, 30926, 30929, 30930, 30930, 30933, 30934, 30935, 30936, 30937, 30938, 30939, 30940, 30941, 30942, 30949, 30952, 30956, 30957, 30958, 30959, 30960, 30961, 30962, 30963, 30964, 30965, 30969, 30970, 30973, 30974, 30975, 30976, 30977, 30978, 30979, 30980, 30982, 30983, 30986, 30987, 30988, 30989, 30990, 30992, 30993, 30994, 30995, 30996, 30997, 30998, 31006, 31007, 31010, 31011, 31012, 31014, 31015, 31016, 31017, 31018, 31019, 31020, 31021, 31022, 31028, 31032, 31033, 31041, 31786

30691 (EPRI-NP—3789) **Corrosion-product buildup on LWR fuel rods. Final report.** Strasser, A.; Sheppard, K.; Santucci, J. (Stoller (S.M.) Corp., New York (USA)). Apr 1985. 284p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920612.

The relationship between water chemistry and crud buildup on fuel rods was evaluated in two Westinghouse PWRs and two General Electric BWRs. Conditions for low and high crud buildup are compared, and the causes discussed. A survey of significant crud incidents in other LWRs is presented, and the causes discussed to the extent they are available. Operating methods that have been effective in minimizing crud deposits on fuel are presented, with some additional recommendations that will help in attaining this objective.

30692 (IA—1404, pp 34-36) **Comparison between WIMS and ANISN-CINDER code systems.** Shayer, Z.; Saphier, D.; Radkowsky, A. Jul 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85780940.

Published in summary form only.

In Research laboratories annual report 1983.

30693 (IAEA-TC—427/5, pp 51-63) **Modelling aspects and the research programme of the PMK-NVH test facility.** Szabados, L.; Toth, I.; Trosztel, I. (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). Jul 1984. NTIS (US Sales Only), PC A14/MF A01. File Number TI. (CONF-8310369—; TC-SR—3).

From Specialists' meeting on experimental and modelling aspects of small-break LOCA; Budapest, Hungary (3 Oct 1983).

Modelling aspects, system description and the preliminary research programme of the PMK-NVH integral type test facility are discussed. The PMK-NVH is a scaled model of the primary circuit of the Paks Nuclear Power Station.

30694 (IAEA-TC—427/5, pp 63-67) **Experimental and analytical studies of loop seal effects on the primary circuit.** Tuomisto, H. (Imatran Voima Oy, Helsinki (Finland)). Jul 1984. NTIS (US Sales Only), PC A14/MF A01. File Number TI. (CONF-8310369—; TC-SR—3).

From Specialists' meeting on experimental and modelling aspects of small-break LOCA; Budapest, Hungary (3 Oct 1983).

The loop seals formed by bends in primary circuit loops may have an important effect on the water level in the reactor core during small and large LOCAs in a cold leg. The loop seal behaviour is not satisfactorily predicted by large computer codes applied to LOCA-analysis. That is why a 1:6.25 scaled primary circuit model was built to study different loop seal effects for the LOVIISA VVER-440 reactor. The tests have been carried out in the Hydraulic Laboratory of Imatran Voima Oy (Imatra Power Co Ltd). The results of these experiments performed in air-water mixture at atmospheric pressure are presented. Some of these tests were already referred to in papers presented in other meetings. An analytical model of the reactor core water level is also briefly discussed. This model was developed in the Technical Research Centre of Finland in order to make extensive studies of different parameters affecting the water level during an accident.

30695 (IAEA-TC—427/5, pp 68-76) **Experimental research of initially subcooled liquid flow from pressure vessels.** Suchanek, M.; Bartak, J. (Statni Vyzkumny Ustav pro Stavbu Stroju, Bechovice (Czechoslovakia)). Jul 1984. NTIS (US Sales Only), PC A14/MF A01. File Number TI. (CONF-8310369—; TC-SR—3).

From Specialists' meeting on experimental and modelling aspects of small-break LOCA; Budapest, Hungary (3 Oct 1983).

This paper presents the results of an experimental research program of initially subcooled liquid flow through channels and orifices from pressure vessels of different volumes (0.2 m^3 and 1.0 m^3) and from a scaled model of the WWER-440 type reactor (scale factor 1:8). Several types of scaled reactor internals of an increasing complexity were used in the model. The initial coolant parameters were 12 MPa and 300 deg. C. Typical time behaviours of the main measured parameters (pressure, temperature, internals displacements, forces) are presented with emphasis on the initial period of coolant discharge affected by propagation of the depressurization rarefaction wave. The effect of several most important parameters (discharge channel or orifice inner diameter, rupture of the inlet or outlet pipe etc.) on the investigated phenomena is discussed. The experimental results are compared with the results obtained with the use of simplified mathematical models describing the different phenomena during discharge: rarefaction wave propagation, nonequilibrium phase change, critical two-phase flow.

30696 (IAEA-TC—427/5, pp 113-134) **Two-phase jet flows and forces.** Celata, G.P.; Cumo, M.; Farello, G.E.; Incalcaterra, P.C. (ENEA, Casaccia (Italy). Centro Ricerche Energia). Jul 1984. NTIS (US Sales Only), PC A14/MF A01. File Number TI. (CONF-8310369—; TC-SR—3).

From Specialists' meeting on experimental and modelling aspects of small-break LOCA; Budapest, Hungary (3 Oct 1983).

With reference to Loss of Coolant Accidents in LWR's, and particularly small-break LOCAs, a detailed picture of the issuing two-phase jets is given. Experimental data concerning critical flows of subcooled and saturated liquid, together with saturated steam data are shown. The analysis refers to the jets external shape (obtained by means of photographic devices) and to the internal pressure distribution (obtained by means of a movable gauge travelling inside the issuing jet).

30697 (IAEA-TC—427/5, pp 237-255) **Computer studies on the applicability of test results on commercial nuclear power plants.** Pfau, H.; Sonneck, G. (Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H. Inst. fuer Reaktorsicherheit). Jul 1984. NTIS (US Sales Only), PC A14/MF A01. File Number TI. (CONF-8310369—; TC-SR—3).

From Specialists' meeting on experimental and modelling aspects of small-break LOCA; Budapest, Hungary (3 Oct 1983).

An analytical study is described which investigates the effects of different parameters and different selected programme options on scaling distortion with respect to real processes. The study uses the intermediate-break test LOFT L5-1 as a reference, and employing RELAP4/MOD6 several models were tried for the LOFT reactor. Since the aim was to simulate the behaviour and the time sequence rather than to duplicate the experiment in all aspects, the number of volumes was reduced to 20 and less.

30698 (IKE—6-149) **Development and verification of a modular program system for calculation of the long-time behavior of pressurized water reactors.** Woerner, A. (Stuttgart Univ. (Germany, F.R.). Inst. fuer Kernenergetik und Energiesysteme; Stuttgart Univ. (Germany, F.R.). Fakultaet 5 - Energietechnik). 14 Nov 1984. 206p. (In German). NTIS (US Sales Only), PC A10/MF A01. File Number DE85751620.

For the fuel management of nuclear power plants the time dependent fuel composition and power distribution within the reactor core has to be determined with high accuracy. The calculation of this long-time behaviour of the pressurized water reactors, taking into account the thermohydraulic feedback on the above mentioned distributions, has been integrated in a modular program system. The essential part of this program system is a newly developped nodal diffusion theory program which allows to describe approximately the local variation of cross sections within a node. The above mentioned computational method, making use of latest cross section data, permits reactor cycle calculations with high accuracy. This has been demonstrated by the verification of two reactor cycles of the Kernkraftwerk Obrigheim. In addition to this physical verification a benchmark problem comparison has been accomplished to prove the efficiency of the modular program system.

30699 (IWGFPT—20, pp 227-241) **Some aspects of plutonium recycling in thermal reactors.** Kamath, H.S.; Purushotham, D.S.C.; Sah, D.N.; Roy, P.R. (Bhabha Atomic Research Centre, Bombay (India). Radiometallurgy Div.). Dec 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85900589. (CONF-8405285—).

From IAEA improved utilization of water reactor fuel with special emphasis on extended burnups and plutonium recycling meeting; Mol, Belgium (7 May 1984).

Plutonium recycling in thermal reactors is of great interest to our nuclear programme. Keeping this in view an experimental irradiation programme using mixed oxide (MOX) fuel has already been started to optimise various fuel design and fabrication parameters. Significant work relating to MOX fuel fabrication flow sheet and quality control methods have been carried out. A computer code PROFESS earlier developed to analyse UO_2 fuel performance is now being extended to predict and analyse the performance of MOX fuel. Two MOX fuel clusters have so far been irradiated to burn-ups beyond 15,000 MWd/Te at linear heat-ratings between 400 to 500 W/cm in a pressurised water loop of our research reactor, CIRUS (40 MWt). Two more MOX fuel clusters are also getting ready for irradiation. This paper discusses the various MOX fuel design concepts and fabrication parameters presently under investigation.

30700 (IWGFPT—20, pp 17-38) **Need for improved uranium utilization in Swiss nuclear power plants: Extended burn-up, Pu-recycle and Gadolinia fuels.** Bay, H. (Nordostschweizerische Kraftwerke A.G., Baden); Bodmer, R. (Kernkraftwerk Goesgen-Daeniken A.G., Daeniken (Switzerland)); Eichenberger, W.; Patak, H. (Elektrizitaetswerk Laufenburg A.G. (Switzerland)); Stratton, R. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland)); Wiest, W. (Bernische Kraftwerke A.G. (Switzerland)). Dec 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85900589. (CONF-8405285—).

From IAEA improved utilization of water reactor fuel with special emphasis on extended burnups and plutonium recycling meeting; Mol, Belgium (7 May 1984).

The three nuclear plants (four reactors) totalling approx. 2 GW(e) installed capacity now operating in Switzerland have stood at or close to the head of the world league table of plant availability and performance since the first went into operation in 1969. A fourth plant (1 GWe) is expected to come on line in 1984. One important reason for the good performance has been the excellent fuel behaviour achieved after some early teething troubles. Conservative fuel ratings and close attention to operating limits have contributed to the very satisfactory performance of the fuel. In spite of this the Swiss Utilities are actively pursuing improved fuel utilization for various reasons which vary from plant to plant depending on the operating philosophy, fuel management aims and characteristics of the plant. Extended burn-up to reduce fuel requirements and spent fuel arisings, longer cycle lengths, fuller utilization of existing cycles by more accurate operating and burn-up predictions, recycling of plutonium for improved fuel cycle economics are being actively examined and the paper will present the current status of these activities.

30701 (IWGFPT—20, pp 39-46) **Impact of extended burnups on core design.** Beltrame, M. (Neutronic Dept., Framatome, Paris La Defense (France)). Dec 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85900589. (CONF-8405285—).

From IAEA improved utilization of water reactor fuel with special emphasis on extended burnups and plutonium recycling meeting; Mol, Belgium (7 May 1984).

Extended fuel burnup in PWR core leads to some problems for the reactor designer. Rather than a superficial survey of all problems we met in our studies, we point out those appearing the most important. The effects of such a high burnup may be classified in three points. Fuel management: We emphasize on the problems linked to the neutronic integrated flux on assembly components and reactor vessel. Reactivity control: Higher initial enrichments increase the reactivity of the core and lead to higher boron concentrations which have a strong impact on auxiliary systems. Plutonium concentrations at the end of life lead to stronger feedback coefficients and increase reactivity defect between full and zero power. This effect reduces the reactivity margin. Reactor control: We give some details on this effect and consequently on the liquid wastes volume.

30702 (IWGFPT—20, pp 86-98) **Belgian contributions to improved fuel utilization.** Bairiot, H.; Deramaix, P.; Vandenberg, C. (Societe Belge pour l'Industrie Nucleaire, Brussels). Dec 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85900589. (CONF-8405285—).

From IAEA improved utilization of water reactor fuel with special emphasis on extended burnups and plutonium recycling meeting; Mol, Belgium (7 May 1984).

Worldwide R and D and irradiation experiments are carried out to improve the fuel utilization and to increase the power plant availability factor. The recycle of Pu and the use of Gd as burnable poison have a positive impact on the improvements to assembly design and to fuel management presently being demonstrated and even commercially implemented. This paper focuses on the importance of Belgian experience acquired in this field.

30703 (IWGFPT—20, pp 98-109) **Japanese fuel study related to extended burn-up and plutonium recycling.** Mishima, Y. (Tokyo Univ. (Japan)). Dec 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85900589. (CONF-8405285—).

From IAEA improved utilization of water reactor fuel with special emphasis on extended burnups and plutonium recycling meeting; Mol, Belgium (7 May 1984).

Overview will be made on the Japanese activities on extended burn-up of LWR fuel and Pu recycling in thermal reactor fuel. As we are planning to recycle residual uranium-235 and plutonium formed through conversion in LWR fuel by reprocessing, the amount of burn-up extension will be made in a somewhat different way from what is carried out in case of one-through use of LWR fuel. Japan joined the Battelle High Burn Up programme to get necessary data. High enrichment fuel with higher gadolinium content has already been licensed to be trially irradiated in power reactor. Elongation of power reactor cycle has already been made up to 400 days and is planned up to 15 months in the next stage. There has been no problem until now, as 24 LWRs in Japan have been operated at the load factor of more than 70% in average during the past 3 years, with practically no fuel failure. Mixed oxide fuel for water reactor has already been successfully used in ATR prototype (pressure tube type, heavy water moderated, boiling light water cooled) to generate electricity without any fuel failure for 3 years and the target burn-up will be enhanced to 30,000 MWD/T (average) in its demonstration reactor of about 600 MWe, to be critical 10 years later. Use of Mox fuel in LWR is planned and authorised in the revised Long term Utilization Programme issued in '82 and trial use of a limited number of assemblies both in BWR and PWRs is planned, the fuel of which is thought to be fabricated in the PNC Tokai Facility. Private facility for Mox fuel is still at the stage of discussion. Related to the commercialization of FBR in Japan, a special committee has been working in JAEC as well as in MITI, and the integrated strategy for the utilization of plutonium in Japan is expected to be established before the respective projects will be put into practice.

30704 (IWGFPT—20, pp 125-133) **Calculation study of the WWER-440 fuel performance for extended burnup.** Kujal, J.; Pazdera, F.; Barta, O. (Ustav Jaderneho Vyzkumu CSKAE, Rez (Czechoslovakia)). Dec 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85900589. (CONF-8405285—).

From IAEA improved utilization of water reactor fuel with special emphasis on extended burnups and plutonium recycling meeting; Mol, Belgium (7 May 1984).

The results of preliminary calculational study of extended burnup cycling schemes impact on WWER-440 fuel performance are presented. Two high burnup schemes were proposed with three and four cycles, resp. Comparison was made with three cycle reference case. The thermal mechanical analysis was performed with PIN and RELA codes. The values of rod internal pressure, fuel centerline temperatures and fuel-cladding gap are expressed as function of power history.

30705 (IWGFPT—20, pp 134-144) **LWR fuel rods for extended burnup - Design and experimental bases.** Gross, H.; Manzel, R. (Kraftwerk Union A.G., Erlangen (Germany, F.R.)). Dec 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85900589. (CONF-8405285—).

From IAEA improved utilization of water reactor fuel with special emphasis on extended burnups and plutonium recycling meeting; Mol, Belgium (7 May 1984).

The increase in the portion of the fuel cycle costs related to reprocessing and intermediate or final storage challenges the fuel engineers to increase the discharge burnups of the fuel by increasing the initial enrichment. The most important aspects to be considered in the design of fuel for extended burnup appear to be waterside corrosion, fission gas release and pressure build-up, and axial fuel rod and assembly growth. The power ramping behaviour (at least for PWR's and BWR's applying PCI remedies) and long term creep deformation of the cladding seem to be of less importance. In connection with higher target burnups and extended cycle lengths burnable poison (Gadolinium) is used. In order to provide an experimental data base for high burnup fuel rods KWU has started very early to irradiate standard fuel rods beyond their initial target burnup. Results of the postirradiation examination of those highly irradiated fuel rods are presented that have also been used for the calibration and verification of the design codes. Analytical and experimental investigations showed, that a reduction of the rod power is advantageous with regard to high burnups. This has led in some cases to fuel assemblies with an increased number of fuel rods and with a decreased rod diameter. These fuel assemblies have an improved potential for high burnups compared to assemblies with higher linear heat generation rate.

30706 (IWGFPT—20, pp 145-148) **High burnup program in the French power plants.** Lavoine, O. (Electricite de France, 92 - Courbevoie. Service Etudes et Projets Thermiques et Nucleaires); Houdaille, B. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)); Cambon, J.L. (Fragema, 69 - Lyon (France)). Dec 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85900589. (CONF-8405285—).

From IAEA improved utilization of water reactor fuel with special emphasis on extended burnups and plutonium recycling meeting; Mol, Belgium (7 May 1984).

E.D.F. has developed a high burnup program in its power plants. In this communication we will present briefly these different actions and particularly the results obtained in a 900 MWe power plant: five assemblies were irradiated during four cycles and have been examined after the fourth cycle - the assembly average burnup was between 41,700 and 47,400 MWd/tu; four fuel rods have been extracted from one assembly for hot cell examinations. The on-site measurements and the hot cell results are presented: the fuel behaved in accordance with predictions. The high burnup program is an important prerequisite to E.D.F.'s future nuclear fuel management strategy.

30707 (IWGFPT—20, pp 149-153) **Review of extended burnup research, development and implementation in the United States.** Lang, P.M. (USDOE, Washington, DC); Franklin, D. (Electric Power Research Inst., Palo Alto, CA (USA)). Dec 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85900589. (CONF-8405285—).

From IAEA improved utilization of water reactor fuel with special emphasis on extended burnups and plutonium recycling meeting; Mol, Belgium (7 May 1984).

This paper reviews the results to date of the various research and development projects on burnup extension of LWR fuel being sponsored by the author's organizations. These projects include a large number of test assembly irradiations in power reactors, both of current-design fuel and of several advanced designs. The burnups attained to date are tabulated and the status of postirradiation examination of these assemblies is reviewed. Current U.S. thinking on the implications of these results on possible fuel life limiting phenomena is presented, together with discussion and prioritization of further work to be done. The further work under discussion includes, in addition to other advanced designs and life limiting effects, economic studies to determine optimum burnups under present and projected future cost structures and the design of desirable extended burnup fuel cycles for power reactors. These include low leakage fuel management, improved burnable absorbers to control power distributions, extended cycle lengths, and practical transitions toward extended burnup. Results of recent studies on the impacts of extended burnup on the external fuel cycle operations of fuel fabrication, fresh fuel storage, spent fuel storage, and spent fuel transportation are briefly reviewed. The majority of U.S. utilities have already made positive decisions to implement at least a first step of burnup extension in their operating reactors. The results of a recent survey of such implementation are presented, with estimates of percentage of reactors going to burnup extension and of average and maximum increases in burnups now committed. The discussion of these results includes review of various utility motivations, both for restraint and for pressing forward with burnup extension. A summary of burnup extensions already achieved is also included.

30708 (IWGFPT—20, pp 154-160) **Summary of SEMO experience with PWR's cores containing Gadolinia bearing fuel in Tihange 1 nuclear power station.** Melice, M.; Jadot, J.J.; Duflou, P. (Compagnie Generale d'Entreprises Electriques et Industrielles, S.A. (ELECTROBEL), Brussels (Belgium)); Wergifosse, C. de (Societe Belgo-Francaise d'Energie Nucleaire Mosane (SEMO) (Belgium)). Dec 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85900589. (CONF-8405285—).

From IAEA improved utilization of water reactor fuel with special emphasis on extended burnups and plutonium recycling meeting; Mol, Belgium (7 May 1984).

Future operating plans for Tihange unit 1 are based on cycle lengths approaching 18 months (from cycle 12). Since cycle 7, Gadolinia bearing assemblies were included in the reload batches in order to evaluate neutronic design methods employed. This Gadolinia program is briefly set out. Comparisons of measured to calculated data following the performance of the Gadolinia assemblies through cycles 7 and 8 are discussed. Loading pattern of cycle 9 including 4 Gadolinia high concentration assemblies and special features of cycle 10 are presented. An original device for "in situ" Gadolinia rod insertion into fresh assemblies is shortly described.

30709 (IWGFPT—20, pp 161-164) **Benefits of extended burnup from a utility perspective.** Kortheuer, J.D.; Snipes, R.G. (Duke Power Co., Lynchburg, VA (USA)); Coleman, T.A. (Babcock and Wilcox Co., Lynchburg, VA (USA)). Dec 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85900589. (CONF-8405285—).

From IAEA improved utilization of water reactor fuel with special emphasis on extended burnups and plutonium recycling meeting; Mol, Belgium (7 May 1984).

Since 1978 Duke Power Company, Arkansas Power and Light, Babcock and Wilcox, and the Department of Energy have been engaged in an extended-burnup development program. This program has been a resounding success in that the original goal of achieving burnups of 40,000 MWd/mtU, about a 20% increase over previous experience, was achieved by four assemblies in 1979, and today's fuel cycles are being designed to this level based on results obtained from the program. Furthermore, the program was amended in 1981 to include both the extension of the fuel performance data base to 50,000 MWd/mtU and the development of the technology to support the use of the fuel-burnable absorber mixture, urania-gadolinia, in pressurized water reactors. The irradiation of an assembly to 50,000 MWd/mtU was successfully completed in 1983 and detailed examinations of the assembly are underway. Five lead test assemblies each containing 12 UO_2-Gd_2O_3 rods began irradiation in Duke Power Company's Oconee Unit 1 reactor in August 1983. The performance of these lead test assemblies in their first cycle has been excellent, having met all physics testing and power distribution comparison criteria. Extended burnup offers benefits for essentially every step in the nuclear fuel cycle: mining, transportation, conversion, enrichment, fabrication, irradiation performance, storage, shipment, and disposal. Increasing the discharge burnup from 30,000 MWd/mtU to 50,000 MWd/mtU reduces yellowcake requirements by about 15% and separative work requirements by 1-3% depending upon the specific fuel cycle application. About 40% fewer fuel assemblies are required, thus, leading to a major reduction in spent fuel generation and significant savings for the back end of the fuel cycle. When used to extend cycle lifetime, e.g., to convert from annual to 18-month fuel cycles, extended burnup can lead to increased reactor availability, higher capacity factors, and lower generating costs.

30710 (IWGFPT—20, pp 165-170) **Fuel management with Gadolinium poison rods.** Bergeron, J.; Lenain, R. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service d'Etudes des Reacteurs et de Mathematiques Appliquees). Dec 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85900589. (CONF-8405285—).

From IAEA improved utilization of water reactor fuel with special emphasis on extended burnups and plutonium recycling meeting; Mol, Belgium (7 May 1984).

The capability of Gadolinium loaded fuel to meet the reactivity control requirements of typical high burn-up PWR (900 MWe) cycles is investigated. Special attention is paid to the search for the fuel characteristics and management, that optimize the core neutron behaviour in most aspects: fuel enrichment in U^{235}, Gadolinium texture (grain size ranging from 0 to 500 μm), number of poisoned rods per assembly, fuel loading pattern (2 or 3 batches), residual poison efficiency ... The main objectives of the study are to ensure a negative moderator temperature coefficient in zero power conditions and to provide an acceptable spatial power distribution according to the usual criteria (two dimensional shape factor Fsub(N)sup(H) limited to 1,435). Finally, the comparative analysis of the thermal transient experienced by UO_2 and UO_2/Gd_2O_3 rods in case of a control rod ejection accident, assesses the consequences of the degraded thermal properties of the Gadolinium loaded fuel and the resulting need for a reduced enrichment in U^{235} within the poisoned rods.

30711 (IWGFPT—20, pp 171-181) **Experimental programmes on Gadolinium fuel utilization in LWR's in Belgium.** Haas, D. (Societe Belge pour l'Industrie Nucleaire, Brussels); Motte, F. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)). Dec 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85900589. (CONF-8405285—).

From IAEA improved utilization of water reactor fuel with special emphasis on extended burnups and plutonium recycling meeting; Mol, Belgium (7 May 1984).

The choice of Gadolinium as burnable poison for reactivity control was first taken in Belgium for the BR3 PWR, in 1971. After some starting problems related to the difficulty in calculating correctly the Gd depletion versus burnup, the methods were progressively improved and the use of Gd was extended by increasing the number of Gd rods and the standard Gd content in BR3 from 3 to 7 w/o Gd_2O_3 in the Gd rods. In parallel, Gd was first used in a large Belgian PWR in Tihange 1 (8 w/o Gd_2O_3, but with natural uranium). Amongst the programmes organized in collaboration between CEN/SCK and BELGONUCLEAIRE: national programmes are going on in BR3 (study of the irradiation behaviour of various types of Gd fuels at high burnup) and are in planning in BR2 (basic neutronic experiments); two programmes sponsored by international partners have been launched: GAIN, which is basically studying the burnup behaviour of different fuel designs and GAP which is devoted to the neutronic codes benchmarking. The present status of both national and international programmes is outlined hereafter.

30712 (IWGFPT—20, pp 182-207) **Post-irradiation examination of plutonium-bearing fuel elements irradiated in LWR power plants. A European Community campaign.** Cadelli, N. (Commission of the European Communities, Brussels (Belgium)); Lippens, M. (Societe Belge pour l'Industrie Nucleaire, Brussels). Dec 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85900589. (CONF-8405285—).

From IAEA improved utilization of water reactor fuel with special emphasis on extended burnups and plutonium recycling meeting; Mol, Belgium (7 May 1984).

In the framework of the E.C. programme "Plutonium Recycling in LWR", a series of post-irradiation examinations were carried out on mixed-oxide fuel elements irradiated in LWR's. The examinations were performed in 10 campaigns on fuel irradiated in the following power reactors: Garigliano, Dodewaard, SENA, Lingen and BR3 as well as in the HFR. The paper subdivided in three parts describes first the extent of the R and D programme for five of these campaigns; that is the main characteristics of 95 examined fuel rods, their irradiation conditions and the examinations techniques involved. Then, the essential experimental results of the programme are summarized: clad deformations, fuel microstructure, fission gas release and gamma activity distributions. The second part of the paper is devoted to the analysis of these results, leading to a comparative description of the in-reactor behaviour of the uranium-plutonium oxide and the uranium oxide fuels. The last part of the paper summarizes the confrontation between the observed in-reactor behaviour and the predictions of the thermo-mechanical fuel behaviour using the COMETHE III-L code and the isotopic compositions anticipated using the ORIGEN-2 code. The campaign is not yet entirely completed but all results so far obtained allow to conclude that: in no case plutonium fuel has perturbed the normal operation of a power reactor; no rod failure due specifically to the behaviour of the mixed-oxide fuel could be detected; the behaviour of the rods, up to a burn-up typical for power LWR, has always been found to be at least as good as that of the traditional uranium oxide rods; the fuel behaviour under irradiation and the evolution of its isotopic composition can be predicted using existing codes with a very good accuracy. The correlation of fission gas release however is not so good for all the experiments.

30713 (IWGFPT—20, pp 208-227) **KWU/ALKEM experience in thermal Pu-recycling.** Roepenack, H. (Alpha Chemie und Metallurgie G.m.b.H. (ALKEM), Hanau (Germany, F.R.)); Schlemmer, F.; Schlosser, G. (Kraftwerk Union A.G., Erlangen (Germany, F.R.)). Dec 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85900589. (CONF-8405285—).

From IAEA improved utilization of water reactor fuel with special emphasis on extended burnups and plutonium recycling meeting; Mol, Belgium (7 May 1984).

Thermal Pu-recycling experience at KWU/ALKEM dates back as far as the mid-60s. Following the successful introduction of test fuel assemblies, thermal Pu-recycling has been demonstrated on a large scale since the beginning of the 70s in the power plants at Kahl (VAK), Gundremmingen (KRB-A) and Obrigheim (KWO). During the last few years improved fabrication processes were developed resulting in MOX-fuel with favourable reprocessing properties. The AUPuC-process, a co-conversion process, is used if the starting material is available as plutonium nitrate solution. In the case of plutonium oxide being the starting material the OCOM-process, a co-milling process, is used. Since 1981 thermal Pu-recycling has been carried on with the improved MOX-fuel at Obrigheim (KWO) and since 1982 at Neckarwestheim (GKN). As agreed with the German utilities in the near future Pu-recycling will be concentrated in PWRs. Optimization of the nuclear design led to a MOX-fuel assembly with a minimum of 2 types of rods of different Pu-content. High flexibility exists in the number of MOX-fuel assemblies to be loaded in PWR cores. Extensive experience has been gained during the large-scale German recycling programmes. The MOX-fuel assemblies inserted up to now exhibit an operating performance which is as good as that of the uranium fuel assemblies supplied by KWU. The experience was extended by the irradiation of special test rods. Postirradiation investigations on MOX-fuel show high mechanical stability, low shrinkage and swelling and good behaviour at power transients. On the basis of this experience the large-scale use of MOX-fuel is technically feasible and will be extended to PWRs of the 1300 MWe type in 1984.

30714 (IWGFPT—20, pp 241-257) **Use of BR3 for the Belgian plutonium recycle irradiation programme.** Charlier, A.; Haas, D.; Bairiot, H. (Societe Belge pour l'Industrie Nucleaire, Brussels); Motte, F. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)). Dec 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85900589. (CONF-8405285—).

From IAEA improved utilization of water reactor fuel with special emphasis on extended burnups and plutonium recycling meeting; Mol, Belgium (7 May 1984).

The Belgian PWR BR3 has been utilized extensively since 20 years for testing the irradiation behaviour of MOX fuel under several operating conditions. In parallel, the increasing proportion (30% of all the rods) of MOX rods in the core as well as the use of Gd as burnable poison for reactivity control, have required to update continuously the neutronic calculation methods. This paper summarizes the main steps of Pu utilization in BR3, with an emphasis on the present situation, and presents the main conclusions on the following two aspects: the neutronic design methods and their validation and the strategies core and assemblies loading patterns; the general mechanical behaviour of MOX fuels, which have been irradiated up to extremely high burnups (up to 80 GWd/tM peak pellet).

30715 (LA-UR—85-1729) **Application of detailed fission-product decay gamma spectra in the calculation of photoneutron spectra from D(γ,n) reactions in PWR fuel.** Wilson, W.B.; Stewart, J.E.; England, T.R.; Perry, R.T. (Los Alamos National Lab., NM (USA); Texas A and M Univ., College Station (USA)). 1985. Contract W-7405-ENG-36. 5p. (CONF-850507—23). NTIS, PC A02/MF A01; GPO Dep. File Number DE85012729.

From International conference on nuclear data for basic and applied science; Santa Fe, NM, USA (13 May 1985).

The magnitude, average neutron energy, and spectrum of the photoneutron source in a PWR fuel is calculated for shutdown times to 100 y using CINDER radionuclide inventory calculations, ENDF/B-V γ line decay spectra, MCNP γ transport calculations, and PHONEX D(γ,n) reaction physics calculations.

30716 (LPA-P—2) **Sizewell 'B' public inquiry. Proof of evidence on noise implications of construction and operation.** Ratcliffe, K. (Suffolk County Council, Ipswich (UK); Suffolk Coastal District Council, Woodbridge (UK)). Apr 1983. 41p. British Library Lending Division, Boston Spa, Wetherby, LS23 7BQ.

The report is in sections entitled: qualification of witness; introduction; background noise; design criteria for steady state operational noise for Sizewell-B; construction noise; traffic noise; case history of construction of other power stations.

30717 (NUREG/CR—3723) **Stress-intensity-factor influence coefficients for surface flaws in pressure vessels.** Ball, D.G.; Bass, B.R.; Bryson, J.W.; Cheverton, R.D.; Drake, J.B. (Oak Ridge National Lab., TN (USA)). Feb 1985. Contract AC05-84OR21400. 49p. (ORNL/CSD/TM—216). NTIS, PC A03/MF A01 - GPO. File Number TI85006633.

In the fracture-mechanics analysis of reactor pressure vessels, stress-intensity-factor influence coefficients are used in conjunction with superposition techniques to reduce the cost of calculating stress-intensity factors. The present study uses a finite-element code, together with a virtual crack extension technique, to obtain influence coefficients for semielliptical surface flaws in a cylinder, and particular emphasis was placed on mesh convergence (less than 1% error was sought in the results from any one mesh construction parameter). Comparison of the coefficients with those obtained by other investigators shows good agreement. Furthermore, stress-intensity factors obtained by superposition for a severe thermal-transient loading condition agree within 1% of the values calculated by a direct finite-element method. Influence coefficients were calculated for three specific axially oriented semielliptical surface flaws. The first was a 2-m-long inner-surface flaw in a nuclear reactor pressure vessel with depth-to-wall-thickness ratios between 0.2 and 0.9. The second was an inner-surface flaw in the reactor vessel with a surface-length-to-depth ratio of 6 and with depth-to-wall-thickness ratios between 0.05 and 0.2. The third was a 1-m-long flaw on the outer surface of a test vessel with depth-to-wall-thickness ratios between 0.1 and 0.9. For the reactor vessel, separate coefficients were calculated for the cladding on the inner surface and for the base-material region. This allows for an accurate accounting of the effect of thermal stresses in the cladding on the stress-intensity factor for surface flaws that extend through the cladding into the base material.

30718 (NUREG/CR—4149) **Ultimate pressure capacity of reinforced and prestressed concrete containments.** Sharma, S.; Wang, Y.K.; Reich, M. (Brookhaven National Lab., Upton, NY (USA)). May 1985. Contract AC02-76CH00016. 91p. (BNL-NUREG—51857). NTIS, PC A05/MF A01 - GPO. File Number TI85012868.

This report presents the results of an in-depth evaluation of current modeling techniques and analysis procedures for determining ultimate pressure capacity of reinforced and prestressed concrete containments. The material used for describing the nonlinear material behavior of concrete and steel are reviewed in detail. Special attention is focused on post-cracking behavior of concrete which controls one of the containment failure modes, i.e., the shear failure. Various finite element idealizations utilized for containment analysis are reviewed. The effects of major assumptions pertaining to containment geometry, basemat restraint, finite element mesh, rebar locations and orientations, are evaluated. Finally, failure analyses of two selected reinforced and prestressed concrete containments are performed and results are compared with those presented in the literature. 27 refs., 25 figs.

30719 (TP—82-36) **Startup and commissioning of pressurized water reactors.** Albert, L.J.; Gilbert, C.F. (Stone and Webster Engineering Corp., Boston, MA (USA)). May 1983. 23p. (CONF-8305259—1). NTIS (US Sales Only), PC A02/MF A01. File Number DE85701494.

From Canadian Nuclear Society commissioning symposium; Toronto, Ontario, Canada (3 May 1983).

A critical phase of plant development is the test, startup, and commissioning period. The effort expended prior to commissioning has a definite effect on the reliability and continuing availability of the plant during its life. This paper describes a test, startup, and commissioning program for a pressurized water reactor (PWR) plant. This program commences with the completion of construction and continues through the turnover of equipment/systems to the owner's startup/ commissioning group. The paper addresses the organization of the test/startup group, planning and scheduling, test procedures and initial testing, staffing and certification of the test group, training of operators, and turnover to the owner.

30720 **Monitoring system for a liquid-cooled nuclear fission reactor.** DeVolpi, A. (to Dept. of Energy). US Patent Application 6-632,743. 20 Jul 1984. 35p. Contract W-31-109-ENG-38.

The invention provides improved means for detecting the water levels in various regions of a water-cooled nuclear power reactor, viz., in the downcomer, in the core, in the inlet and outlet plenums, at the head, and elsewhere; and also for detecting the density of the water in these regions. The invention utilizes a plurality of exterior gamma radiation detectors and a collimator technique operable to sense separate regions of the reactor vessel to give respectively, unique signals for these regions, whereby comparative analysis of these signals can be used to advise of the presence and density of cooling water in the vessel.

30721 (CE-Trans—7693) **Activation products and dose rate, using Unit A of the Biblis Nuclear Power Station as an example.** Paffrath, G.; Ambros, R. Translated from *VGB Kraftwerkstechnik ;* **60**: No. 2, 121-124(1980). 11p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85900178. DE85900178

During normal reactor operation, the dose rate at the primary circuit components is generated by fission and activation products. When the plant is run down to standstill, the fission products decay in accordance with their physical half-life and, in addition, are extracted from the primary coolant by means of ion exchangers at decontamination ratios of >100. The activation products which exist suspended in the coolant, partially in ion form and partially as undissolved particles, are generally exchanged only at a decontamination ratio of <10 at the ion exchangers. The half-life of the nuclides relevant to dose is of the order of one year and longer. Thus the activation products absorbed or adsorbed at the protective layers of the inner surface of the primary circuit components during the shut-down process are the main contributors to the dose rate found after reactor switch-off. Depending on the dose rate generated by the activation products, special radiation safety measures such as installing screens, limiting the working time or decontaminating systems and single components must be provided during shut-downs and inspections for inspections and repairs on primary circuit components.

2103 Power Reactors, Non-breeding, Graphite Moderated

REFER ALSO TO CITATION(S) 29908, 29937, 30761, 30771, 30854, 30855, 30860, 30894, 30943, 30954, 31461, 31462, 31568

30722 (IA—1404, pp 30-33) **Thermohydraulic transient analysis of the HTGR pebble bed reactor.** Saphier, D.; Rodnizky, J. (Israel Atomic Energy Commission, Tel Aviv); Meister, G. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.)). Jul 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85780940.

Published in summary form only.

In Research laboratories annual report 1983.

2104 Power Reactors, Non-breeding, Otherwise Moderated Or Unmoderated

REFER ALSO TO CITATION(S) 29894, 30914, 30944, 30945, 30946, 30947, 30948, 30951

30723 **(AGESTA—1-027) OECD/NEA Agesta Decontamination Project. Phase 1, final report. Volume 1. Project description and overview of results.** (Studsvik Energiteknik AB, Nykoeping (Sweden)). Dec 1982. 25p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85011305.

The objective of the Agesta Decontamination Project, which has been organized by the Nuclear Energy Agency, Paris, is to utilize the four primary loops of the Agesta reactor to demonstrate decontamination methods for PWR primary systems. The first phase of the project consisted of laboratory scale tests. The test programme consisted of decontamination tests on steam generator tubing and other active material from Agesta and number of operating reactors as well as material compatibility tests on standardized samples of a representative selection of modern PWR primary system materials. The results show that all six processes in general met the acceptance criteria both regarding decontamination and corrosion. The decontamination results with the hard chemistries were rather uneven. 4 refs., 2 figs., 5 tabs.

30724 ***(BWC—83-93) Start-up support for New Brunswick Electric's Point Lepreau nuclear steam generators.** Schneider, W.; Leroux, A. (Babcock and Wilcox Canada Ltd., Cambridge, Ontario). May 1983. 9p. (CONF-8305259—2). NTIS (US Sales Only), PC A02/MF A01. File Number DE85701495.

From Canadian Nuclear Society commissioning symposium; Toronto, Ontario, Canada (3 May 1983).

The start-up of the 600 MW Point Lepreau reactor provided the opportunity for direct involvement in the important low and medium power start-up phase which was of particular interest because this was a first-of-a-kind reactor type incorporating a new steam generator design. Support included test assistance and test results interpretation for the thermal hydraulic performance of the steam generators and in particular, investigation of water level response to operating pressure, power and feed flow. This work resulted in both a greatly improved understanding of transient characteristics and in a number of beneficial refinements in the control methods.

30725 (IAEA-TC—427/5, pp 77-93) **Flow behaviour in a CANDU horizontal fuel channel from stagnant subcooled initial conditions.** Caplan, M.Z.; Gulshani, P.; Holmes, R.W.; Wright, A.C.D. (Atomic Energy of Canada Ltd., Sheridan Park, Ontario. CANDU Operations). Jul 1984. NTIS (US Sales Only), PC A14/MF A01. File Number TI. (CONF-8310369—; TC-SR—3).

From Specialists' meeting on experimental and modelling aspects of small-break LOCA; Budapest, Hungary (3 Oct 1983).

The flow behaviour in a CANDU primary system with horizontal fuel channels is described following a small inlet header break. With the primary pumps running, emergency coolant injection is in the forward direction so that the channel outlet feeders remain warmer than the inlet thereby promoting forward natural circulation. However, the break force opposes the forward driving force. Should the primary pumps run down after the circuit has refilled, there is a break size for which the natural circulation force is balanced by the break force and channels could, theoretically, stagnate. Result of visualization and of full-size channel tests on channel flow behaviour from an initially stagnant channel condition are discussed. After a channel stagnation, the decay power heats the coolant to saturation. Steam is then formed and the coolant stratifies. The steam expands into the subcooled water in the end fitting in a chugging type of flow regime due to steam condensation. After the end fitting reaches the saturation temperature, steam is able to penetrate into the vertical feeder thereby initiating a large buoyancy induced flow which refills the channel. The duration of stagnation is shown to be sensitive to small asymmetries in the initial conditions. A small initial flow can significantly shorten the occurrence and/or duration of boiling as has been confirmed by reactor experience.

30726 (IAEA-TC—427/5, pp 99-113) **Two-phase natural circulation experiments in a pressurized water loop with figure-of-eight symmetry.** Ardron, K.H.; Krishnan, V.S.; McGee, G.R.; Anderson, J.W.D.; Hawley, E.H. (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment). Jul 1984. NTIS (US Sales Only), PC A14/MF A01. File Number TI. (CONF-8310369—; TC-SR—3).

From Specialists' meeting on experimental and modelling aspects of small-break LOCA; Budapest, Hungary (3 Oct 1983).

To provide information on two-phase natural circulation in a CANDU-type circuit geometry a series of tests has been performed in the RD-12 loop at Whiteshell Nuclear Research Establishment. RD-12 is a 10-MPa pressurized-water loop containing two active boilers, two pumps, and two or four heated horizontal channels arranged in a symmetrical figure-of-eight configuration characterizing the CANDU, primary heat-transport system. In the tests, single-phase natural circulation was first established in the loop, and void was then introduced by controlled draining with the surge tank (pressurizer) valved out of the system. The experiments indicate that a stable, two-phase, natural circulation flow can usually be established. However, as the void in the loop is increased, large-amplitude flow oscillations can occur. Initially the flow oscillations in the two halves of the loop are usually very nearly 180 deg. out-of-phase. However, as the loop inventory is decreased, an in-phase oscillation component is observed. In tests with two parallel heated channels in each half loop, oscillations associated with mass transfer between the channel pairs are also observed. Although the flow oscillations can lead to intermittent dry-out of the upper elements of the heater-rod assemblies in the horizontal channels, the natural circulation cooling appears to be effective until about 50 percent of the loop inventory is drained; sustained flow stratification then occurs in the heated channels, leading to heater temperature excursions. The paper reviews the experimental results obtained and describes the evolution of natural circulation flow in particular cases as voidage is progressively increased. The stability behaviour is discussed briefly with reference to a simple stability model.

30727 **(INFO—0080) Exporting the Canadian licensing program.** Whelan, D.J. (Atomic Energy Control Board, Ottawa, Ontario (Canada)). Jun 1981. 6p. (CONF-8106200—29). NTIS (US Sales Only), PC A02/MF A01. File Number DE85701281.

From 21. annual international conference of Canadian Nuclear Association and 2. annual conference of Canadian Nuclear Society; Ottawa, Canada (8 Jun 1981).

This paper deals with the problems of an overseas regulatory agency in licensing a Canadian-supplied nuclear plant which is referenced to a plant in Canada. Firstly, the general problems associated with the use of a reference plant are discussed. This is followed by a discussion of specific problems which arise from the licensing practices in Canada. The paper concludes with recommendations to simplify the task of demonstrating the licensability of an overseas CANDU plant.

30728 (IWGFPT—20, pp 70-74) **Thorium fuels for heavy water reactors. Romanian experience.** Glodeanu, F.; Mirion, I.; Mehedinteanu, S.; Balan, V. (Institutul de Reactori Nucleari Energetici, Pitesti (Romania)). Dec 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85900589. (CONF-8405285—).

From IAEA improved utilization of water reactor fuel with special emphasis on extended burnups and plutonium recycling meeting; Mol, Belgium (7 May 1984).

The renewed interest in thorium fuel cycle due to the increased demand for fissile materials has resulted in speeding up the related research and development activities. For heavy water reactors the thorium cycles, especially SSET, are very promising and many efforts are made to demonstrate their feasibility. In our country, at INPR, the research and development activity has been initiated in the following areas: the conceptual design of thorium bearing fuel elements; fuel modelling; nuclear grade thorium dioxide powder technology; mixed oxide fuel technology. In the design area, the key factors in performance limitation, especially at extended burnup have been accounted and different remedies proposed. An irradiation programme has been settled and will start this year. The modelling activities are focused on mixed oxide behaviour and material data measurements are in progress. In the nuclear grade thorium powder technology area, a good piece of work has been done to develop an integrated technology for monasite processing (thorium being a by-product in lanthanides extraction). As regards the mixed oxide fuel technology, efforts have been made to obtain $(ThU)O_2$ pellets with good homogeneity and high density at different compositions. Besides the mixing powders route, other non-conventional technologies for refabrication like: microspheres, pellet impregnation and clay extrusion are studied. Experimental fuel rods for irradiation testing have been manufactured.

30729 (IWGFPT—20, pp 110-124) **Graphite disc - oxide fuel elements for high powers and extended burnups.** MacDonald, R.D.; Hastings, I.J. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Dec 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85900589. (CONF-8405285—).

From IAEA improved utilization of water reactor fuel with special emphasis on extended burnups and plutonium recycling meeting; Mol, Belgium (7 May 1984).

We have irradiated graphite disc annular UO_2 fuel elements over a burnup range of 120 to 800 MW.h/kgU (5000 to 33,000 MWd/teU) at linear powers between 30 and 70 kW/m. Temperature limits for fuel-to-disc and disc-to-sheath contact have been fixed; the length/diameter ratio of the pellets and disc thickness to optimize cooling have also been established. The test irradiations confirmed the excellent dimensional stability of disc fuel. Average sheath strains were generally less than 0.2% and circumferential ridges over pellet interfaces were half the heights of ridges on elements without discs. The fission gas released from disc/annular elements was up to four times less than that from annular fuel alone. The internal stability of the fuel was acceptable; although the central hole in the pellets changed shape, the discs retained their effectiveness in cooling the fuel. Disc compatibility with the UO_2 fuel and Zircaloy sheath was good. Disc fuel elements were tolerant of power ramps at high burnups, and showed acceptable detect behaviour. A computer code to predict the irradiation behaviour of disc fuel elements has been developed and verified against data from inreactor tests.

30730 (IWGFPT—20, pp 257-269) **Development of ATR MOX fuels.** Domoto, K.; Yokouchi, Y. (Power Reactor and Nuclear Fuel Development Corp., Tokyo (Japan)); Mishima, Y. (Tokyo Univ. (Japan)). Dec 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85900589. (CONF-8405285—).

From IAEA improved utilization of water reactor fuel with special emphasis on extended burnups and plutonium recycling meeting; Mol, Belgium (7 May 1984).

Power Reactor and Nuclear Fuel Corporation (PNC) has carried out a number of irradiation examination programmes in order to clarify the behavior of plutonium-uranium mixed oxide (MOX) fuels and to develop design codes. Important items to evaluate the performace of MOX fuel rods are mainly cladding deformation and fission gas release. This report presents results of MOX fuel in-pile tests and their post-irradiation examinations in HBWR (Halden Boiling Water Reactor) and SGHWR. IN HBWR, on-line measurements are being performed on fuel center line temperature, plenum pressure, cladding elongation and fuel stach length. Peak fuel burnup is about 25,000 Mwd/t at present and peak linear heat rating was 458 W/cm. The behaviours of MOX fuel rods are evaluated by comparing the on-line measurements with anlayses made by design codes. In SGHWR, measurements of fission gas release and cladding deformation in the post-irradiation examination were performed. Peak burnup was 9,860 Mwd/t and peak linear heat rating 489 W/cm. Evaluation of irradiated MOX fuels was made by comparing irradiation results with the calculated results by design codes. Since fretting corrosion of cladding by spacer grids has an important influence on the integrity of the fuel assembly and its endurance, fretting corrosion tests, using a full scale fuel assembly, have been performed over 30,000 hours and no problem has been observed.

30731 (RPC-E—83/47) **Innovative ultrasonics for power plant commissioning.** Murphy, R.V.; Alikhan, S. (New Brunswick Research and Productivity Council, Fredericton (Canada)). May 1983. 30p. (CONF-8305259—3). NTIS (US Sales Only), PC A03/MF A01. File Number DE85701496.

From Canadian Nuclear Society commissioning symposium; Toronto, Ontario, Canada (3 May 1983).

During the commissioning of a nuclear power plant, the usual role of ultrasonics is associated with nondestructive testing of welds. There is, however, a variety of undesirable conditions associated with the fluids carried through the various reactor systems which may be just as important to station operation. A variety of unusual ultrasonic techniques has been developed for testing fluid systems at the Point Lepreau Generating Station. This paper uses the experience gained at the Point Lepreau reactor to illustrate the valuable information which can be gained from these measurements, such as: fluid level in pipes and headers; fluid level in pressure vessels; detection, and sizing of debris in pipes; in situ measurement and verification of orifice condition; detection and location of cavitation, water hammer, valve leakage; quantitative measurement of gate movement within the body of an inservice valve; determination of valve position; detection and imaging of flow separation; detection and location of leaks in concrete containment structures; verification of design flows; balancing of loop flows; and detection of low flow. The application of these techniques at other reactor sites is also discussed.

2105 Power Reactors, Breeding

REFER ALSO TO CITATION(S) 30686, 30771, 30823, 30848, 30849, 30850, 30851, 30852, 30857, 30878, 30909, 30927, 30928, 31034

30732 (BNL—36312) **Spallator - accelerator breeder.** Steinberg, M. (Brookhaven National Lab., Upton, NY (USA)). Jan 1985. Contract AC02-76CH00016. 8p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85012276.

The concept involves the use of spallation neutrons produced by interaction of a high energy proton (1 to 2 GeV) from a linear accelerator (LINAC) with a heavy metal target (uranium). The principal spallator concept is based on generating fissile fuel for use in LWR nuclear power plants. The spallator functions in conjunction with a reprocessing plant to regenerate and produce the Pu-239 or U-233 for fabrication into fresh LWR reactor fuel elements. Advances in proton accelerator technology has provided a solid base for predicting performance and optimizing the design of a reliable, continuous wave, high-current LINAC required by a fissile fuel production machine.

30733 **(CONF-850410—40) Forced-convection boiling tests performed in parallel simulated LMR fuel assemblies.** Rose, S.D.; Carbajo, J.J.; Levin, A.E.; Lloyd, D.B.; Montgomery, B.H.; Wantland, J.L. (Oak Ridge National Lab., TN (USA)). 21 Apr 1985. Contract AC05-84OR21400. 8p. NTIS, PC A02/MF A01. File Number TI85011429.

From ANS/ENS fast reactor safety meeting; Knoxville, TN, USA (21 Apr 1985).

Forced-convection tests have been carried out using parallel simulated Liquid Metal Reactor fuel assemblies in an engineering-scale sodium loop, the Thermal-Hydraulic Out-of-Reactor Safety facility. The tests, performed under single- and two-phase conditions, have shown that for low forced-convection flow there is significant flow augmentation by thermal convection, an important phenomenon under degraded shutdown heat removal conditions in an LMR. The power and flows required for boiling and dryout to occur are much higher than decay heat levels. The experimental evidence supports analytical results that heat removal from an LMR is possible with a degraded shutdown heat removal system.

30734 **(CONF-850410—42) Evaluation of a hanging core support concept for LMR application.** Burelbach, J.P.; Cha, B.K.; Huebotter, P.R.; Kann, W.J.; Pan, Y.C.; Saiveau, J.G.; Seidensticker, R.W.; Wu, T.S. (Argonne National Lab., IL (USA)). 1985. Contract W-31-109-ENG-38. 19p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85012116.

From ANS/ENS fast reactor safety meeting; Knoxville, TN, USA (21 Apr 1985).

The paper describes an innovative design concept for a liquid metal reactor (LMR) core support structure (CSS). A hanging core support structure is described and analyzed. The design offers inherent safety features, constructability advantages, and potential cost reductions. Some safety considerations are examined which include the in-service inspection (ISI), the backup support system and the structural behavior in a hypothetical case of a broken beam in the core support structure.

30735 **(CONF-850610—2) Steam generator model for real-time analysis.** Tzanos, C.P. (Argonne National Lab., IL (USA)). 1985. Contract W-31-109-ENG-38. 7p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85006194.

From Annual meeting of the American Nuclear Society; Boston, MA, USA (9 Jun 1985).

Plant safety as well as plant availability can significantly be improved if functions such as data validation, plant state verification and fault identification are automated. This can be achieved if computers are utilized, with plant models that run in real-time, for continuous on-line plant information processing and analysis. Such models can also be used in plant simulators for operator training. This paper presents a model for real-time analysis of a once-through liquid-metal fast breeder reactor (LMFBR) steam generator.

30736 **(CONF-850610—12-Summ.) Proposed fuel cycle for the Integral Fast Reactor.** Burris, L.; Walters, L.C. (Argonne National Lab., IL (USA)). 1985. Contract W-31-109-ENG-38. 6p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85006224.

From Annual meeting of the American Nuclear Society; Boston, MA, USA (9 Jun 1985).

One of the key features of ANL's Integral Fast Reactor (IFR) concept is a close-coupled fuel cycle. The proposed fuel cycle is similar to that demonstrated over the first five to six years of operation of EBR-II, when a fuel cycle facility adjacent to EBR-II was operated to reprocess and refabricate rapidly fuel discharged from the EBR-II. Locating the IFR and its fuel cycle facility on the same site makes the IFR a self-contained system. Because the reactor fuel and the uranium blanket are metals, pyrometallurgical processes (shortned to "pyroprocesses") have been chosen. The objectives of the IFR processes for the reactor fuel and blanket materials are to (1) recover fissionable materials in high yield; (2) remove fission products adequately from the reactor fuel, e.g., a decontamination factor of 10 to 100; and (3) upgrade the concentration of plutonium in uranium sufficiently to replenish the fissile-material content of the reactor fuel. After the fuel has been reconstituted, new fuel elements will be fabricated for recycle to the reactor.

30737 **(CTA-IEAV-NT—019/83) Studies of LMFBR: method of analysis and some results.** Ishiguro, Y.; Dias, A.F.; Nascimento, J.A. do. (Centro Tecnico Aeroespacial, Sao Jose dos Campos (Brazil). Inst. de Estudos Avancados). 1983. 67p. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. File Number DE85701497.

Some results of recent studies of LMFBR characteristics are summarized. A two-dimensional model of the LMFBR is taken from a publication and used as the base model for the analysis. Axial structures are added to the base model and a three-dimensional (Δ - Z) calculation has been done. Two dimensional (Δ and RZ) calculations are compared with the three-dimensional and published results. The eigenvalue, flux and power distributions, breeding characteristics, control rod worth, sodium-void and Doppler reactivities are analysed. Calculations are done by CITATION using six-group cross sections collapsed regionwise by EXPANDA in one-dimensional geometries from the 70-group JFS library. Burnup calculations of a simplified thorium-cycle LMFBR have also been done in the RZ geometry. Principal results of the studies are: (1) the JFS library appears adequate for predicting overall characteristics of an LMFBR, (2) the sodium void reactivity is negative within - 25 cm from the outer boundary of the core, (3) the halflife of Pa-233 must be considered explicitly in burnup analyses, and (4) two-dimensional (RZ and Δ) calculations can be used iteratively to analyze three-dimensional reactor systems.

30738 **(CTA-IEAV-NT—023/83) Some basic considerations about the Brazilian nuclear program.** Ishiguro, Y. (Centro Tecnico Aeroespacial, Sao Jose dos Campos (Brazil). Inst. de Estudos Avancados). 1983. 9p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. File Number DE85701498.

In order to assure the continued utilization of fission energy development of fast breeder reactors is a necessity. Binary fueled LMFBRs are proposed as the best type for future Brazilian nuclear systems. The inherent safety characteristics are superior to current fast breeder reactors and an efficient utilization of thorium can be realized. A possible strategy for the development of the reactor and related technologies are discussed.

30739 **(CTA-IEAV-NT—024/83) Project of a binary breeder reactor and its inherent safety.** Nascimento, J.A. do; Dias, A.F.; Ishiguro, Y. (Centro Tecnico Aeroespacial, Sao Jose dos Campos (Brazil). Inst. de Estudos Avancados). 1983. 12p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. File Number DE85701499.

A core layout for the binary breeder reactor (BBR) is developed based on the results of preliminary burnup calculations. In the U^{233}/TH fueled inner core, the apparent breeding ratio is low due to the accumulation of Pa-233 in the first few months of operation. The loss of reactivity during this time is approximatelly 3%. The BBR requires more reactivity control than Pu/U-fueled LMFBRs and the core layout developed has 19 control rod assemblies in the inner core. Three aspects related to the inherent safety of the BBR have been studied: radial distribution of the sodium-void reactivity, zone-wise Doppler reactivity, and the delayed neutron fractions. Results show excellent safety characteristics of the BBR.

30740 **(CTA-IEAV-NT—025/83) Burnup characteristics of binary breeder reactors.** Dias, A.F.; Nascimento, J.A. do; Ishiguro, Y. (Centro Tecnico Aeroespacial, Sao Jose dos Campos (Brazil). Inst. de Estudos Avancados). 1983. 15p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. File Number DE85701500.

Burnup calculations of a binary breeder reactor have been done for two cases of fueling. In one case the U^{233}/TH fueled inner core and the Pu/U-fueled outer core have the same number of fuel assemblies. In the other case two outermost rings in the inner core are Pu/U-fueled. The second case is considered for an initial phase of thorim cycle introduction when the supply of U^{233} could be limited. Results show an efficient breeding on the thorium cycle in both cases.

30741 (CTA-IEAV-NT—026/83) Option for the Brazilian nuclear project: necessity of fast breeder reactors and core design for an experimental fast reactor. Ishiguro, Y. (Centro Tecnico Aeroespacial, Sao Jose dos Campos (Brazil). Inst. de Estudos Avancados). 1983. 16p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. File Number DE85701501.

In order to assure the continued utilization of fission energy, development of fast breeder reactors (FBRs) is a necessity. Binary fueled LMFBRs are proposed as the best type for future Brazilian nuclear systems. The inherent safety characteristics are superior to current FBRs and an efficient utilization of the abundant thorium is possible. A first step and a basic tool for the development of FBR technologies is the construction and operation of an experimental fast reactor (EFR). A series of core designs for a 90 MW EFR is studied and possible options and the magnitudes of principal parameters are identified. Flexible modifications of the core and sufficiently high fast fluxes for fuel and materials irradiations appear possible.

30742 (DOE/CL/98004—33) Properties of concrete at elevated temperatures. Burrow, R.C.; Griswold, G.D.; Oland, C.B. (Burns and Roe, Inc., Oradell, NJ (USA). Breeder Reactor Div.; Burns and Roe, Inc., Oak Ridge, TN (USA); Oak Ridge National Lab., TN (USA)). 1979. Contract AC15-76CL98004. 5p. (CONF-7909281—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE85009002.

From 3. American Society of Civil Engineers/EMD specialty conference; Austin, TX, USA (17 Sep 1979).

This paper describes the ongoing testing program developed to determine the variations in the physical (thermal) and mechanical (strength) properties of limestone aggregate structural concrete, and the physical (thermal) properties of perlite insulating concrete exposed to sustained elevated temperatures up to 621°C (1150°F). The testing program developed by Burns and Roe, Inc. and Oak Ridge National Laboratory is formulated to identify the behavioral trends from the effects of elevated temperature on the mechanical properties of unconfined compressive strength, shear strength, reinforcing bar bond strength, sustained loading (creep) behavior, and the physical properties of thermal expansion, conductivity and diffusivity.

30743 (INIS-mf—9424) German SNQ-project and its research options. Bauer, G.S. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.)). Jun 1983. 20p. (CONF-8306262—2). NTIS (US Sales Only), PC A02/MF A01. File Number DE85780936.

From Belgian Nuclear Society annual meeting on advanced uses of accelerators on the nuclear fuel cycle; Brussels, Belgium (13 Jun 1983).

Some of the current ideas of applying accelerators in the nuclear fuel cycle for fuel breeding and waste management are reviewed with respect to physics feasibility and energy efficiency. While fertile-to-fissile conversion and actinide burning seem possible from a physics and energy economy point of view, fission product transmutation is more difficult to assess. R+D-work required for a more detailed assessment and a design study that could be used in an overall systems analysis is briefly summarized. A short description of the German project for a high power spallation neutron source is given and further possible fields of research at the facility are outlined. (AF).

30744 (ORNL—6154) Characterization of modified 9 Cr-1 Mo steel extruded pipe. Sikka, V.K.; Hart, M.D. (Oak Ridge National Lab., TN (USA)). Apr 1985. Contract AC05-84OR21400. 30p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85012056.

The fabrication of hot-extruded pipe of modified 9 Cr-1 Mo steel at Cameron Iron Works is described. The report also deals with the tempering response; tensile, Charpy impact, and creep properties; and microstructure of the hot-extruded pipe. The tensile properties of the pipe are compared with the average and average - 1.65 standard error of estimate curves for various product forms of several commercial heats of this alloy. The creep-rupture properties are compared with the average curve for various product forms of the commercial heats.

30745 (RRC—53) Fuel-cladding chemical interaction in mixed oxide liquid metal fast breeder reactors: a review. Khanna, A.S. (Reactor Research Centre, Kalpakkam (India)). 1982. 33p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85900954.

Fuel-clad chemical interaction is one of the important areas of concrn in the fast breeder technology. In this report, an attempt has been made to review the various aspects of this phenomenon. The report summarizes the results from post-irradiation examination, inpile and out of pile experiments which have been reported in the literature and discusses the present understanding of these complex phenomenon in terms of various models proposed so far. A brief introduction is also given on various ways of combating fuel-clad chemical interaction. In the end a few recommendations are made on the possible areas of future investigations.

30746 (RRC—56) Activity report of Reactor Engineering Laboratory, 1981. Veerasamy, R. (ed.). (Reactor Research Centre, Kalpakkam (India)). 1982. 58p. NTIS (US Sales Only), PC A04/MF A01. File Number DE85900957.

This report summarizes activities concerning the R and D as well as Prototype Testing initiated or continued during 1981 at the Reactor Engineering Laboratory. Considerable work was carried out in connection with prototype testing of components in support of the Fast Breeder Test Reactor which is under construction. This includes mainly calibration of permanent magnet flowmeters in sodium, tests on Control Rod Drive Mechanisms in hot argon and determination of response time of Core Thermocouples. Similarly, work was initiated in advanced instrumentation for sodium cooled reactors. This is concerned with development of noise analysis techniques for detection of sub-assembly faults by means of acoustic and thermal noise. Work in the area of ultrasonic viewing technique was also started and significant progress in constructing suitable probe for viewing in sodium has been achieved. Design work for the large sodium pump for the proposed prototype Fast Breeder Reactor has progressed well and the reference concept has been selected.

30747 (RRC—61) Analysis of ZPR-9 Assembly 31, the Advanced Fuels Program Carbide: Benchmark Critical Assembly. Ganesan, S.; Ramanadhan, M.M.; Gopalakrishnan, V. (Reactor Research Centre, Kalpakkam (India). Fast Reactor Group). 1983. 22p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85900951.

The analysis of the 1000 litre (core) sized carbide benchmark fast reactor assembly using the RRC non adjusted multigroup set and the adjusted French 1969 set shows no surprising results as compared to our predictional capability for oxide cores. This note documents the details of analysis performed for this carbide ZPR-9 Assembly 31. The results for central worths agree with those reported by US team using ENDF/B-IV set and also show that non adjusted set may not be satisfactory in prediction of central worths of materials. On the other hand, the K/sub eff/ is best predicted by the non adjusted ENDF/B-IV based RRC set and the ratio of fission reaction rates are predicted to the same extent by the two sets available at RRC.

30748 (RRC—63) Heat to heat variations in the creep rupture strength of a modified AISI 316 grade stainless steel. Mathew, M.D.; Mannan, S.L.; Ray, S.K.; Rodriguez, P. (Reactor Research Centre, Kalpakkam (India)). 1984. 19p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85900997.

A modified AISI 316 grade stainless steel has been used as the construction material for a large number of structural and core components for the Fast Breeder Test Reactor. The creep rupture properties of this material belonging to these different heats have been studied at temperatures of 823, 873 and 923 K in the stress range of 120 to 300 MPa for test durations upto 60,000 hours. Considerable variations in the creep rupture strength were observed from one heat to another, at all the three temperatures. The scaling of applied stress with the ultimate tensile strength at the corresponding temperatures, however, reduced the heat-to-heat variations to some extent. The heat-to-heat variations are attributed to differences in the amount of interstitial solutes in the steel as well as in grain size.

30749 **Thermo-mechanical analysis of concrete in LMFBR programs.** Marchertas, A.H. (Argonne National Lab., IL (USA). Reactor Analysis and Safety Div.). *Nuclear Engineering and Design;* **82**: No. 1, 47-62(Oct 1984). (CONF-830864—).

From 4. international seminar on fluid/structure dynamics and containment of nuclear reactors; Chicago, IL, USA (29 Aug 1983).

The R and D program described in this paper represents the structural mechanics effort underway and planned at ANL as an attempt to better understand the behavior of concrete structures in LMFBR plants where such structures are subjected to high temperature levels. This paper describes the analytical tools formulated and incorporated into the thermo-mechanical computer code called TEMP-STRESS. Emphasis in this paper is placed on describing the short-time and long-time constitutive formulation for concrete. The primary constitutive relation uses an elasto-plastic technique to simulate concrete nonlinearities, utilizes the von Mises ellipsoid as the loading surface, and assumes a four-parameter failure surface. Post-failure treatment is different when considering surface elements as opposed to internal elements. Creep of the concrete at temperatures up to about 400°C is approximated by a rate-type creep law using Maxwell chain technique. The creep model accounts for moisture and pore pressure disposition of the concrete.

30750 **Fast reactor power plant design having heat pipe heat exchanger.** Huebotter, P.R.; McLennan, G.A. (to Dept. of Energy). US Patent Application 6-645-654. 30 Aug 1984. 15p. Contract W-31-109-ENG-38.

The invention relates to a pool-type fission reactor power plant design having a reactor vessel containing a primary coolant (such as liquid sodium), and a steam expansion device powered by a pressurized water/steam coolant system. Heat pipe means are disposed between the primary and water coolants to complete the heat transfer therebetween. The heat pipes are vertically oriented, penetrating the reactor deck and being directly submerged in the primary coolant. A U-tube or line passes through each heat pipe, extended over most of the length of the heat pipe and having its walls spaced from but closely proximate to and generally facing the surrounding walls of the heat pipe. The water/steam coolant loop includes each U-tube and the steam expansion device. A heat transfer medium (such as mercury) fills each of the heat pipes. The thermal energy from the primary coolant is transferred to the water coolant by isothermal evaporation-condensation of the heat transfer medium between the heat pipe and U-tube walls, the heat transfer medium moving within the heat pipe primarily transversely between these walls.

2106 Power Reactors, Auxiliary, Mobile, Package, And Transportable

30751 **(DOE/OR/21400—T124) Strategic defense initiative.** Nichols, J.P. (Martin Marietta Energy Systems, Oak Ridge, TN (USA)). 1985. Contract AC05-84OR21400. 17p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85012778.

The Engineering Technology Division has a leading role, including that of program management, in a major new programmatic thrust of the Oak Ridge National Laboratory that is in support of the national Strategic Defense Initiative (SDI). It is appropriate for the Laboratory to become significantly involved in the program because several of the most promising SDI technologies are in areas for which ORNL (together with Y-12 and K-25) have strong capabilities and significant resources. The initial ORNL work in support of the SDI program is focused on three technologies in which ORNL has extensive experience and traditionally strong research and development programs: (1) space nuclear power, (2) flywheel energy storage, and (3) neutral particle beams. The space nuclear program will utilize our capabilities in areas such as refractory materials, high-temperature alkali metal systems, shielding, and instrumentation. Space nuclear reactors capable of supplying multi-megawatt levels of electrical power on a continuous and long-term basis are envisioned to be required for a variety of SDI surveillance satellites and space-borne weapons platforms. The feasibility of an alkali metal Rankine power conversion cycle, which has promise of providing high power with a very low system mass, is planned for study.

30752 **(GA-A—17773) SP-100 thermionic technology program annual integrated technical progress report for the period ending September 30, 1984.** Holland, J.W. (ed.). (GA Technologies, Inc., San Diego, CA (USA)). Nov 1984. Contract AC03-84SF11906;AC03-84SF12192;AC03-84SF12193. 228p. NTIS, PC A11/MF A01; 1; GPO Dep. File Number DE85012311.

The thermionic technology program addresses the feasibility issues of a seven-year-life thermionic fuel element (TFE) for the SP-100 Thermionic Reactor Space Power System. These issues relate to the extension of TFE lifetime from three to seven years, one of the SP-100 requirements. The technology to support three-year lifetimes was demonstrated in the earlier TFE development program conducted in the late-1960s and 1970s. Primary life-limiting factors were recognized to be thermionic emitter dimensional increases due to swelling of the nuclear fuel and electrical structural damage from fast neutrons. The 1984-85 technology program is investigating the fueled emitter and insulator lifetime issues, both experimentally and analytically. The goal is to analytically project the lifetime of the fueled emitter and insulator and to experimentally verify these projection methods. In 1984, the efforts were largely devoted to the design and building of fueled emitters for irradiation in 1985, validation of fuel-emitter models, development of irradiation-resistant metal-ceramic seal and sheath insulator, modeling of insulator lifetime, and development of wide-spread, high-performance thermionic converters.

30753 **Aerospace technology and commercial nuclear power.** Grey, J. (ed.). New York, NY; American Institute of Aeronautics and Astronautics (1982). 138p. (CONF-8111227—). American Inst. of Aeronautics and Astronautics, 1633 Broadway, New York, NY 10019. File Number TI85010198. Contract FG01-82NE37887.

From Workshop on aerospace technology and commercial nuclear power; Williamsburg, VA, USA (18 Nov 1981).

The objective of the workshop conference upon which this report is based was to compare the technologies, institutions, and procedures of the aerospace and commercial nuclear power industries, to seek commonalities and contrasts, and to identify the most promising avenues for beneficial transfer of information, technology, and procedures between the two industries. Seven working groups convened at the conference to meet this objective. Their general conclusions are presented. The working group topics included: powerplant deseign; plant safety and operations; powerplant control technology and integration; plant facility construction and standardization; economic and financial analyses; public awareness and understanding; and management of nuclear waste and spent fuel.

2107 Regulation And Licensing

REFER ALSO TO CITATION(S) 30727, 30841, 30844, 30931, 30962, 30966, 30971

30754 **(DEMO—83/3G) Proposal for a quality assurance regulation for nuclear power plants.** Bartzis, J.G. (Democritos Nuclear Research Center, Athens (Greece)). Mar 1983. 28p. (In Greek). NTIS (US Sales Only), PC A03/MF A01. File Number DE85701519.

In the present work an attempt has been made to develop a regulation necessary to implement quality assurance in all phases of a nuclear power plant installation. The present work is considered as a basis towards developing a final regulation for Quality Assurance in Nuclear Power Plants. The proposal is based on the IAEA 50-C-QA Code of Practice.

30755 (DOE/CH/91005—T2) Thorium fuel cycles in light water reactors (NASAP fuel cycle analysis). Monthly project status report, December 1978. Matzie, R.A. (Combustion Engineering, Inc., Windsor, CT (USA)). 10 Jan 1979. Contract AT02-76CH91005. 17p. (COO—2426-164). NTIS, PC A02/MF A01; GPO Dep. File Number DE85004525.

Information is presented concerning the uranium resource utilization improvements in the once-through PWR fuel cycle and the NRC licensing evaluation support.

30756 (DOE/CH/91005—T3) Licensing assessment of extended-burnup fuel. Monthly project status letter, December 1, 1979-December 31, 1979. Matzie, R.A.; Liu, Y. (Combustion Engineering, Inc., Windsor, CT (USA)). Jan 1980. Contract AT02-76CH91005. 12p. (COO—2426-206). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004524.

The licensing impact of high-burnup fuel in the ex-core fuel cycle steps of transportation, fabrication, and storage has been determined. Fuel performance evaluations and model code verification are presented. Scoping type safety analyses have been performed for a number of design transients and postulated accidents for the five-batch, extended-burnup fuel cycle. Loss-of-coolant accident methods are reviewed.

30757 (EGG-EA—6735) Conformance to Regulatory Guide 1.97, Clinton Power Station, Unit No. 1 (Docket No. 50-461). VanderBeek, R. (EG and G Idaho, Inc., Idaho Falls (USA)). Apr 1985. Contract AC07-76ID01570. 22p. NTIS, PC A02/MF A01 - GPO. File Number TI85011675.

This EG and G Idaho, Inc., report reviews the Clinton Power Station, Unit No. 1 submittal for Regulatory Guide 1.97 and identifies areas of nonconformance. Exceptions to the guidelines are evaluated and those areas where sufficient basis for acceptability is not provided are identified.

30758 (EGG-EA—6848) Conformance to Regulatory Guide 1.97, Millstone Nuclear Power Station, Unit No. 1 (Docket No. 50-245). Udy, A.C. (EG and G Idaho, Inc., Idaho Falls (USA)). Apr 1985. Contract AC07-76ID01570. 19p. NTIS, PC A02/MF A01 - GPO. File Number TI85012318.

This report reviews the submittals for Regulatory Guide 1.97, Revision 2, for Unit No. 1 of the Millstone Nuclear Power Station and identifies areas of nonconformance to the regulatory guide. Exceptions to Regulatory Guide 1.97 are evaluated and those areas where sufficient basis for acceptability is not provided are identified.

30759 (INFO—0083) Atomic Energy Control Board. Modus operandi. Blackman, N.S.; Gummer, W.K. (Atomic Energy Control Board, Ottawa, Ontario (Canada)). Feb 1982. 20p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85701282.

This paper has been prepared to provide an overview of the responsibilities and activities of the Atomic Energy Control Board. It is designed to address questions that are often asked concerning the establishment of the Atomic Energy Control Board, its enabling legislation, licensing and compliance activities, federal-provincial relationships, international obligations, and communications with the public.

30760 (NUREG—0040-Vol.9-No.1) Licensee contractor and vendor inspection status report. Quarterly report, January-March 1985. Volume 9, No. 1. (Nuclear Regulatory Commission, Washington, DC (USA). Office of Inspection and Enforcement). May 1985. 219p. NTIS, PC A10/MF A01 - GPO. File Number TI85901494.

This periodical covers the results of inspections performed by the NRC's Vendor Program Branch that have been distributed to the inspected organizations during the period from January 1985 through March 1985. Also included in this issue are the results of certain inspections performed prior to January 1985 that were not included in previous issues of NUREG-0040.

30761 (NUREG—0748-Vol.5-No.3) Operating reactors licensing actions summary. Volume 5, No. 3. (Nuclear Regulatory Commission, Washington, DC (USA). Office of Resource Management). May 1985. 337p. NTIS, PC A15/MF A01 - GPO. File Number TI85901504.

The "Operating Reactors Licensing Actions Summary" is designed to provide the management of the Nuclear Regulatory Commission (NRC) with an overview of licensing actions dealing with operating power and nonpower reactors. These reports utilize data collected from the Division of Licensing in the Office of Nuclear Reactor Regulation and are prepared by the Office of Resource Management.

30762 (NUREG—0936-Vol.4-No.1) NRC Regulatory Agenda. Quarterly report, January-March 1985. Volume 4, No. 1. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Rules and Records). May 1985. 200p. NTIS, PC A09/MF A01 - GPO. File Number TI85901537.

The Regulatory Agenda is a quarterly compilation of all rules on which the NRC has proposed, or is considering action as well as those on which it has recently completed action, and all petitions for rulemaking which have been received and are pending disposition by the Commission. This report covers the period from January through March, 1985.

30763 (NUREG—1132) Technical specifications: Diablo Canyon Nuclear Power Plant, Unit No. 2 (Docket No. 50-323). Appendix "A" to License No. DPR-81. (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Apr 1985. 464p. NTIS, PC A20/MF A01 - GPO. File Number TI85901439.

Information is presented concerning the limiting conditions for operation for the reactivity control systems, instrumentation, power distribution limits, reactor coolant system, emergency core cooling system, containment systems, plant systems, electrical power systems, refueling operations, special test exceptions, radioactive effluents, and radiological environmental monitoring.

30764 (NUREG—1133) Technical Specifications: Palo Verde Nuclear Generating Station, Unit No. 1 (Docket No. 50-528). Appendix "A" to License No. NPF-41. (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). May 1985. 514p. NTIS, PC A22/MF A01 - GPO. File Number TI85901552.

Information on the limiting conditions for operation is presented concerning reactivity control systems, power distribution limits, instrumentation, reactor coolant system, emergency core cooling system, containment systems, plant systems, electrical power systems, refueling operations, special test exceptions, radioactive effluents, and radiological environmental monitoring.

2108 Economics

REFER ALSO TO CITATION(S) 30736

30765 (IWGFPT—20, pp 80-86) **Alternative routes to improved fuel utilization: Analysis of near-term economic incentives.** Salo, J.P. (Industrial Power Company Ltd., Helsinki (Finland)); Vieno, T.; Vira, J. (Nuclear Engineering Lab., Technical Research Centre of Finland, Helsinki (Finland)). Dec 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85900589. (CONF-8405285—).

From IAEA improved utilization of water reactor fuel with special emphasis on extended burnups and plutonium recycling meeting; Mol, Belgium (7 May 1984).

The potential for savings in the nuclear fuel cycle costs is discussed from the point of view of a single utility. The analysis is concentrated on the existing and near-term economic incentives for improved fuel utilization, and the context is that of a small country without domestic fuel cycle services. In the uranium fuel cycle the extended burnup produces savings in the uranium feed as well as in the fuel fabrication and waste management requirements. The front-end fuel cycle cost impact is evaluated for BWRs. In the back-end part the situation is more specific of the concrete back-end solution.

Estimates for savings in the cost of direct disposal of spent fuel are presented for a Finnish case. The economics of recycle is reviewed from a recent study on the use of MOX fuel in the Finnish BWRs. The results from a comparison with once-through alternative show that spent fuel reprocessing with consequent recycle of uranium and plutonium would be economically justified only with very high uranium prices.

30766 (NP—5770191, pp 10.1-10.61) **Effect of scale and quantity on the cost and performance of energy technologies. A literature review.** Hill, D. Jan 1984. NTIS (US Sales Only), PC A16/MF A01. File Number DE85770191.

In Technological development and its impact on the future energy system. Appendix 1. Evaluation commissioned by the Danish Ministry of Energy.

The promise of economies of scale in construction led to a great leap forward in the size of power plants in the U.S. to 1000 MWe or more. Traditionally, a "six-tenths power law" stated that cost increased by only half with a doubling of plant size, reducing cost per unit of capacity to 75%. Problems during construction in the past two decades have largely nullified the expected savings. Thermal efficiency improves with size in both coal and nuclear plants, but there is statistical evidence that plant availability declines. These countervailing trends suggest that an optimal size for nuclear plants may be somewhat less than 1000 MWe. Judged by a study of the cost of electricity generated during the 1970s, however, operational savings substantially restored economies of scale to nuclear plants but not to coal plants. The alternative to building larger plants is to build more small plants. In field construction, a second plant at the same site costs about 90% of the first, and a doubling of the number of plants built by an architect-engineer appears to reduce average cost to about 93%. In the few cases where learning curves are mentioned in manufacturing studies of new energy technologies, however, a reduction in cost to only about 90% with a doubling of quantity is assumed. Most of the cost of new energy technologies such as photovoltaic arrays and fuel cells will be due to conventional equipment, structure, and manufacturing methods. It should therefore be possible to estimate size-quantity cost tradeoffs with some confidence to help establish optimal plant or module sizes.

30767 (NUREG/CR—3626-Vol.2) **Maintenance Personnel Performance Simulation (MAPPS) model: description of model content, structure, and sensitivity testing. Volume 2.** Siegel, A.I.; Bartter, W.D.; Wolf, J.J.; Knee, H.E. (Oak Ridge National Lab., TN (USA); Applied Psychological Services, Inc., Wayne, PA (USA)). Dec 1984. Contract AC05-84OR21400. 318p. (ORNL/TM—9041/V2). NTIS, PC A14/MF A01 - GPO. File Number TI85008300.

This volume of NUREG/CR-3626 presents details of the content, structure, and sensitivity testing of the Maintenance Personnel Performance Simulation (MAPPS) model that was described in summary in volume one of this report. The MAPPS model is a generalized stochastic computer simulation model developed to simulate the performance of maintenance personnel in nuclear power plants. The MAPPS model considers workplace, maintenance technician, motivation, human factors, and task oriented variables to yield predictive information about the effects of these variables on successful maintenance task performance. All major model variables are discussed in detail and their implementation and interactive effects are outlined. The model was examined for disqualifying defects from a number of viewpoints, including sensitivity testing. This examination led to the identification of some minor recalibration efforts which were carried out. These positive results indicate that MAPPS is ready for initial and controlled applications which are in conformity with its purposes.

30768 (NUREG/CR—4206) **Select review of the recent (1979-1983) behavioral research literature on training simulators.** Laughery, K.R. (Micro Analysis and Design, Boulder, CO (USA)). May 1985. Contract AC05-84OR21400. 50p. (ORNL/TM—9445). NTIS, PC A03/MF A01 - GPO. File Number TI85011583.

This report summarizes some selected reports of behavioral research performed in the years 1979 to 1983 on training simulator application technology, and discusses findings related to nuclear power plant operators' simulator training. Findings are organized as related to the design, testing, and use of training simulators. Topics include Simulator Fidelity in Training Effectiveness, Operator Performance Measurement, Measuring Simulator Effectiveness, and Simulator Utilization Practices.

30769 **Estimating the cost of delaying a nuclear power plant: methodology and application.** Hill, L.J.; Tepel, R.C.; Van Dyke, J.W. (Oak Ridge National Lab., TN). *Energy Systems and Policy;* 9: No. 2, 197-216(1985).

This paper presents an analysis of an actual 24-month nuclear power plant licensing delay under alternate assumptions about regulatory practice, sources of replacement power, and the cost of the plant. The analysis focuses on both the delay period and periods subsequent to the delay. The methodology utilized to simulate the impacts involved the recursive interaction of a generation-costing program to estimate fuel-replacement costs and a financial regulatory model to concomitantly determine the impact on the utility, its ratepayers, and security issues. The results indicate that a licensing delay has an adverse impact on the utility's internal generation of funds and financial indicators used to evaluate financial soundness. The direction of impact on electricity rates is contingent on the source of fuel used for replacement power. 5 references, 5 tables.

22 NUCLEAR REACTOR TECHNOLOGY

2201 Theory And Calculation

REFER ALSO TO CITATION(S) 30698, 31746

30770 (BLG—571) **CASSANDRE: a two-dimensional multigroup diffusion code for reactor transients analysis.** Arien, B.; Siebertz, A.; Devooght, J.; Mund, E. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)). Sep 1984. 73p. NTIS (US Sales Only), PC A04/MF A01. File Number DE85701284.

CASSANDRE is a two-dimensional (x-y or r-z) finite element neutronics code with thermohydraulics feedback for reactor dynamics prior to the dissassembly phase. It uses the multigroup neutron diffusion theory. Its main characteristics are the use of a generalized quasistatic model, the use of a flexible multigroup point-kinetics algorithm allowing for spectral matching and the use of a finite element description. The code was conceived in order to be coupled with any thermohydraulics module, although thermohydraulics feedback is only considered in r-z geometry. In steady state criticality search is possible either by control rod insertion or by homogeneous poisoning of the coolant. This report describes in detail the theoretical developments on which the code is based.

30771 (IA—1404, pp 25) **Recent developments in the DSNP simulation language.** Saphier, D. Jul 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85780940.

Published in summary form only.
In Research laboratories annual report 1983.

30772 (IA—1404, pp 26-27) **Improved integration schemes in DSNP.** Saphier, D; Bartal, Y.; Rodnizky, Y. Jul 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85780940.

Published in summary form only.
In Research laboratories annual report 1983.

30773 (IA—1404, pp 27-28) **Improved decay heat model for DSNP.** Saphier, D.; Gal, D. Jul 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85780940.

Published in summary form only.
In Research laboratories annual report 1983.

30774 (IA—1404, pp 29-30) **SIGNI. A simplified lumped-parameter steam generator model.** Gal, D.G.; Saphier, D. Jul 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85780940.

Published in summary form only.
In Research laboratories annual report 1983.

30775 (IA—1404, pp 36-37) **Effect of neutron spectra on the plutonium discharge composition.** Shayer, Z.; Saphier, D. (Israel Atomic Energy Commission, Tel Aviv); Radkowsky, A. (Tel Aviv Univ. (Israel)). Jul 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85780940.

Published in summary form only.

In Research laboratories annual report 1983.

30776 (IA—1404, pp 41) **Evaluation of heat transfer coefficient in aiding mixed convection on a vertical flat plate with uniform heat flux.** Barnea, Y.; Shai, I. Jul 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85780940.

Published in summary form only.

In Research laboratories annual report 1983.

30777 (IC—84/20) **Transformation law for response fluxes within the collision probability method.** Wio, H.S. (International Centre for Theoretical Physics, Trieste (Italy)). Mar 1984. 10p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85701285.

By means of Takahashi's transformation law connecting two collision probability matrices of the same subregion division but with different cross-sections, a new transformation law connecting the corresponding response flux matrices has been found.

30778 (LA-UR—85-1730) **Application of evaluated fission-product delayed-neutron precursor data in reactor kinetics calculations.** Perry, R.T.; Wilson, W.B.; England, T.R.; Brady, M.C. (Los Alamos National Lab., NM (USA); Texas A and M Univ., College Station (USA)). 1985. Contract W-7405-ENG-36. 5p. (CONF-850507—17). NTIS, PC A02/MF A01; GPO Dep. File Number DE85012728.

From International conference on nuclear data for basic and applied science; Santa Fe, NM, USA (13 May 1985).

Evaluated fission-product yield and decay data have been used to describe 105 delayed neutron precursors explicitly in point reactor kinetics calculations. Results calculated for ^{235}U thermal fission show that rod-drop reactivity values obtained from kinetics calculations with 6-group precursor data are considerably higher than those calculated with explicit delayed-neutron precursor data. The calculated kinetics associated with positive reactivity steps are significantly different.

30779 (NRCN—536) **Core design and operation optimization methods based on time-dependent perturbation theory.** Greenspan, E. (Israel Atomic Energy Commission, Beersheba. Nuclear Research Center-Negev). Aug 1983. 44p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85701488.

A general approach for the optimization of nuclear reactor core design and operation is outlined; it is based on two cornerstones: a newly developed time-dependent (or burnup-dependent) perturbation theory for nonlinear problems and a succesive iteration technique. The resulting approach is capable of handling realistic reactor models using computational methods of any degree of sophistication desired, while accounting for all the constraints imposed. Three general optimization strategies, different in the way for handling the constraints, are formulated.

30780 (NUREG/CR—0200-Vol.1) **SCALE: a modular code system for performing standardized computer analyses for licensing evaluation. Volume 1. Control modules.** (Oak Ridge National Lab., TN (USA)). Dec 1984. Contract AC05-84OR21400. 835p. (ORNL/NUREG/CSD—2/Vol.1). NTIS, PC A99/MF A01 - GPO. File Number TI85007563.

This manual provides documentation for a new, multi-faceted computational system called SCALE (Standardized Computer Analyses for Licensing Evaluation) that has been developed to provide a standard analysis tool for use by the NRC staff and licensees in evaluating nuclear fuel facility and package designs. The SCALE system consists of several automated analytical sequences (control modules) which perform criticality, shielding, and/or heat transfer calculations with a minimum of user-required input. The computer codes (functional modules) used within each analytical sequence can also be run in a stand-alone fashion or coupled together in a sequence determined by the user. Volume 1 describes the following control modules: a one-dimensional criticality safety analysis module; an enhanced criticality safety analysis module with an optimum pitch search option; a coupled one-dimensional depletion and shielding analysis module; an automated Monte Carlo shielding analysis module; and a two-dimensional heat transfer analysis of fuel casks. Separate abstracts are provided for each control module description.

30781 (NUREG/CR—0200-Vol.1, pp vp, Section C1) **CSAS1: a one-dimensional criticality safety analysis module.** Bucholz, J.A. (Oak Ridge National Lab., TN). Dec 1984. NTIS, PC A99/MF A01. File Number TI85007563. (ORNL/NUREG/CSD—2/Vol.1). Contract W-7405-ENG-26.

In SCALE: a modular code system for performing standardized computer analyses for licensing evaluation. Volume 1. Control modules.

Under contract with the Nuclear Regulatory Commission, the Computer Sciences Division at Oak Ridge National Laboratory has developed the SCALE system for performing Standardized Computer Analyses for Licensing Evaluation of nuclear systems. The SCALE system includes a number of selected data libraries as well as various calculational modules for performing criticality, shielding and heat transfer analyses. This document describes the CSAS1 control module which shields the group-averaged cross-section data for the given situation and performs a one-dimensional discrete ordinates calculation to obtain the effective neutron multiplication factor (k-eff) for the configuration described by the user. Subsections are: introduction, program flow, input, sample problems, and error messages.

30782 (NUREG/CR—0200-Vol.1, pp vp, Section C2) **CSAS2: a multidimensional criticality safety analysis module.** Bucholz, J.A. (Oak Ridge National Lab., TN). Dec 1984. NTIS, PC A99/MF A01. File Number TI85007563. (ORNL/NUREG/CSD—2/Vol.1). Contract W-7405-ENG-26.

In SCALE: a modular code system for performing standardized computer analyses for licensing evaluation. Volume 1. Control modules.

Under contract with the Nuclear Regulatory Commission, the Computer Sciences Division at Oak Ridge National Laboratory has developed the SCALE system for performing Standardized Computer Analyses for Licensing Evaluation of nuclear systems. The SCALE system includes a number of selected data libraries as well as various calculational modules for performing criticality, shielding and heat transfer analyses. This document describes the CSAS2 control module which shields the group-averaged cross-section data for the given situation and performs a multidimensional Monte Carlo calculation to obtain the effective neutron multiplication factor (k-eff) for the configuration described by the user. Subsections are: introduction, program flow, input, sample problems, and error messages.

30783 (NUREG/CR—0200-Vol.1, pp vp, Section 4) **CSAS4: an enhanced criticality safety analysis module with an optimum pitch search option.** Landers, N.F.; Petrie, L.M. (Oak Ridge National Lab., TN). Dec 1984. NTIS, PC A99/MF A01. File Number TI85007563. (ORNL/NUREG/CSD—2/Vol.1).

In SCALE: a modular code system for performing standardized computer analyses for licensing evaluation. Volume 1. Control modules.

CSAS4 and CSAS4X were developed to provide an optimum pitch search capability for three-dimensional problems in the SCALE system. They have been upgraded to increase their search capabilities and to interface with KENO V.a rather than KENO V. This expands the geometrical capabilities to allow arrays of arrays, holes, variable chords for hemicylinders and hemispheres, and inline printer plots. Several control sequences are available within the CSAS4-CSAS4X family. These control sequences activate the cross-section processing codes BONAMI-S and NITAWL-S to provide resonance-corrected cross sections. Control modules ending with X utilize XSDRNPM-S to provide a cell-weighted mixture cross section. ICE-S is used by CSASI and CSASIX to provide a Monte Carlo formatted mixed cross-section library. KENO V.a is used to calculate the effective neutron multiplication factor (k-effective) of the system. The search capability is achieved by repeatedly activating the modules MODIFY to alter the pitch or other dimensions and KENO V.a to calculate the k-effective for the new pitch or dimensions. The control sequences described within this document were developed simultaneously and are closely related. Subsections are: introduction/theory, program flow, input/output, error messages, and sample problems.

30784 (NUREG/CR—0200-Vol.1, pp vp, Section S3) **SAS3: an automated Monte Carlo shielding analysis module.** West, J.T. (Oak Ridge National Lab., TN). Dec 1984. NTIS, PC A99/MF A01. File Number TI85007563. (ORNL/NUREG/CSD—2/Vol.1). Contract W-7405-ENG-26.

In SCALE: a modular code system for performing standardized computer analyses for licensing evaluation. Volume 1. Control modules.

SCALE SAS3 is the SCALE Shielding Analytical Sequence for three-dimensional geometry problems. The system incorporates the simple input processor found in CSAS1 with the radiation transport capabilities of the MORSE-SGC/S Monte Carlo code. This allows automated Nordheim resonance correction processing with the three-dimensional geometry features of the new combinatorial MARS (Multiple Array System). The system executes in sequence, the SAS3 Input Processor, BONAMI-S, NITAWL-S, XSDRNPM-S (optionally), ICE-S, and the MORSE-SGC/S codes. Subsections are: introduction, program flow, input, and sample problem.

30785 **(NUREG/CR—0200-Vol.2) SCALE: a modular code system for performing standardized computer analyses for licensing evaluation. Volume 2. Functional modules.** (Oak Ridge National Lab., TN (USA)). Dec 1984. Contract AC05-84OR21400. 1747p. (ORNL/NUREG/CSD—2/Vol.2). NTIS, PC A99/MF A01 - GPO. File Number TI85007576.

This manual provides documentation for a new multi-faceted computational system called SCALE (Standardized Computer Analyses for Licensing Evaluation) that has been developed to provide a standard analysis tool for use by the NRC staff and licensees in evaluating nuclear facilities and package designs. Volume 2 describes the computer codes (functional modules) used within the criticality, shielding, and heat transfer calculation control modules. Separate abstracts are provided for the functional modules available: resonance self-shielding by the Bondarenko method; resonance self-shielding by the Nordheim method; a one-dimensional discrete-ordinates program for transport analysis; calculation of fluxes and dose rates outside a shield; improved Monte Carlo criticality program; processing of problem-dependent cross sections and neutron spectral data; calculation of fuel depletion, transmutation, fission product buildup and decay; mixing of multigroup cross sections; neutron and photon Monte Carlo transport analyses (advanced geometry); heat conduction (finite difference formulation); 3-D geometry plotting program; temperature distribution plotting programs; and plotting program to verify heat transfer input data.

30786 (NUREG/CR—0200-Vol.2, pp vp, Section F1) **BONAMI-S: resonance self-shielding by the Bondarenko method.** Greene, N.M. Dec 1984. NTIS, PC A99/MF A01. File Number TI85007576. (ORNL/NUREG/CSD—2/Vol.2). Contract W-7405-ENG-26.

In SCALE: a modular code system for performing standardized computer analyses for licensing evaluation. Volume 2. Functional modules.

BONAMI-S is a module of the SCALE system which is used to perform Bondarenko calculations for resonance self-shielding. Cross sections and Bondarenko factor data are input from an AMPX master library. The output is written as an AMPX master library. A wide variety of options is provided for different lattices and cell geometries through the use of Dancoff approximations. A novel interpolational scheme is used which avoids many of the problems of the widely employed Lagrangian schemes.

30787 (NUREG/CR—0200-Vol.2, pp vp, Section F2) **NITAWL-S: scale system module for performing resonance shielding and working library production.** Westfall, R.M.; Petrie, L.M.; Greene, N.M.; Lucius, J.L. (Oak Ridge National Lab., TN). Dec 1984. NTIS, PC A99/MF A01. File Number TI85007576. (ORNL/NUREG/CSD—2/Vol.2). Contract W-7405-ENG-26.

In SCALE: a modular code system for performing standardized computer analyses for licensing evaluation. Volume 2. Functional modules.

NITAWL-S is a module that is required by many calculational sequences in the SCALE system. Its major function is to collect data from up to three input cross section libraries and to process, reformat, and write the information onto a working library for use in a transport calculation. It can also serve as a production resonance calculation module for those nuclides which have resonance parameters included in their basic cross section data. In this case, the Nordheim Integral treatment and a simplified unresolved treatment are employed. This document describes the resonance theory, all numerical procedures, the computer related requirements and the input and output of NITAWL-S.

30788 (NUREG/CR—0200-Vol.2, pp vp, Section F3) **XSDRNPM-S: a one-dimensional discrete-ordinates code for transport analysis.** Greene, N.M.; Petrie, L.M. (Oak Ridge National Lab., TN). Dec 1984. NTIS, PC A99/MF A01. File Number TI85007576. (ORNL/NUREG/CSD—2/Vol.2). Contract W-7405-ENG-26.

In SCALE: a modular code system for performing standardized computer analyses for licensing evaluation. Volume 2. Functional modules.

XSDRNPM-S is a discrete ordinates code which solves the one-dimensional Boltzmann equation in slab, cylindrical or spherical coordinates. Alternately, the user can select P_1 diffusion theory, infinite medium theory or B/sub n/ theory. A variety of calculational types are available, including fixed source, eigenvalue, or search calculations. In SCALE XSDRNPM-S is used for several purposes: eigenvalue (k-effective) determination, cross section collapsing, shielding analysis, and for producing bias-factors for use in Monte Carlo shielding calculations.

30789 (NUREG/CR—0200-Vol.2, pp vp, Section F4) **XSDOSE: a module for calculating fluxes and dose rates at points outside a shield.** Bucholz, J.A. (Oak Ridge National Lab., TN). Dec 1984. NTIS, PC A99/MF A01. File Number TI85007576. (ORNL/NUREG/CSD—2/Vol.2). Contract W-7405-ENG-26.

In SCALE: a modular code system for performing standardized computer analyses for licensing evaluation. Volume 2. Functional modules.

Under contract with the Nuclear Regulatory Commission, the Computer Sciences Division at Oak Ridge National Laboratory has developed the SCALE system for performing Standardized Computer Analyses for Licensing Evaluation of nuclear systems. The SCALE system includes a number of selected data libraries as well as various calculational modules for performing criticality, shielding and heat transfer analyses. This document describes the XSDOSE code which is used in conjunction with XSDRNPM to compute the neutron/gamma flux and the resulting dose at various points outside a finite cylinder or sphere. It may also be used to compute the flux and/or dose at various points due to a finite rectangular surface source or a circular disc. The code assumes that the outgoing angular flux distribution on the rectangle, cylinder, sphere, or disc is independent of position and that the surrounding media is a void. Unlike previous codes, the numerical technique employed in XSDOSE is suitable for points on, close to, or far from the source.

30790 (NUREG/CR—0200-Vol.2, pp vp, Section F5) **KENO IV/S: an improved Monte Carlo criticality program.** Petrie, L.M.; Landers, N.F. (Oak Ridge National Lab., TN). Dec 1984. NTIS, PC A99/MF A01. File Number TI85007576. (ORNL/NUREG/CSD—2/Vol.2). Contract W-7405-ENG-26.

In SCALE: a modular code system for performing standardized computer analyses for licensing evaluation. Volume 2. Functional modules.

KENO IV is a multigroup Monte Carlo criticality program written for the IBM 360 computers. It executes rapidly and is flexibly dimensioned so the allowed size of a problem (i.e., the number of energy groups, number of geometry cards, etc., is arbitrary) is limited only by the total data storage required. The input data, with the exception of cross sections, fission spectra and albedos, may be entered in free form. The geometry input is quite simple to prepare and complicated three-dimensional systems can often be described with a minimum of effort. The results calculated by KENO IV include k-effective, lifetime and generation time, energy-dependent leakages and absorptions, energy- and region-dependent fluxes and region-dependent fission densities. Criticality searches can be made on unit dimensions or on the number of units in an array. This report includes a summary of the theory utilized by KENO IV, a section describing the logical program flow, a compilation of the error messages printed by the code and a comprehensive data guide for preparing input to the code.

30791 (NUREG/CR—0200-Vol.2, pp vp, Section F6) **COUPLE: SCALE system module to process problem-dependent cross sections and neutron spectral data for ORIGEN-S analyses.** Hermann, O.W. (Oak Ridge National Lab., TN). Dec 1984. NTIS, PC A99/MF A01. File Number TI85007576. (ORNL/NUREG/CSD—2/Vol.2).

In SCALE: a modular code system for performing standardized computer analyses for licensing evaluation. Volume 2. Functional modules.

The COUPLE Code automatically couples problem-dependent cross sections constants and flux weighting factors into libraries input to ORIGEN-S, for performing calculations of nuclear reactor isotope depletion and generation inventories and their associated sources and afterheats. In effect, the technique permits ORIGEN-S to apply multi-energy-group neutron cross section data. The chief input required by COUPLE is simply a Working Library produced directly by the AMPX code system or the SCALE code system from neutronics analyses computed by BONAMI-S, NITAWL-S and XSDRNPM-S. Also, any of the nuclear data contained in ORIGEN-S Binary Libraries may be updated by the code. The COUPLE Code is one of the functional modules executed by the SAS2 Control Module of the SCALE code system. Subsections are: introduction, theory, program structure, input, and sample problems.

30792 (NUREG/CR—0200-Vol.2, pp vp, Section F7) **ORIGEN-S: SCALE system module to calculate fuel depletion, actinide transmutation, fission product buildup and decay, and associated radiation source terms.** Hermann, O.W.; Westfall, R.M. (Oak Ridge National Lab., TN). Dec 1984. NTIS, PC A99/MF A01. File Number TI85007576. (ORNL/NUREG/CSD—2/Vol.2).

In SCALE: a modular code system for performing standardized computer analyses for licensing evaluation. Volume 2. Functional modules.

ORIGEN-S computes time-dependent concentrations and source terms of a large number of isotopes, which are simultaneously generated or depleted through neutronic transmutation, fission, radioactive decay, input feed rates and physical or chemical removal rates. The calculations may pertain to fuel irradiation within nuclear reactors, or the storage, management, transportation or subsequent chemical processing of removed fuel elements. The matrix exponential expansion model of the ORIGEN code is unaltered in ORIGEN-S. Essentially all features of ORIGEN were retained, expanded or supplemented within new computations. The primary objective of ORIGEN-S, as requested by the Nuclear Regulatory Commission, is that the calculations may utilize the multi-energy-group cross sections from any currently processed standardized ENDF/B data base. This purpose has been implemented through the prior execution of codes within either the SCALE System or the AMPX System, developed at the Oak Ridge National Laboratory. These codes compute flux-weighted cross sections, simulating conditions within any given reactor fuel assembly, and convert the data into a library that can be input to ORIGEN-S. Time-dependent libraries may be produced, reflecting fuel composition variations during irradiation. Presented in the document are: detailed and condensed input instructions, model theory, features available, range of applicability, brief subroutine descriptions, sample input, and I/O requirements.

30793 (NUREG/CR—0200-Vol.2, pp vp, Section F8) **ICE-S: module to mix multigroup cross sections.** Greene, N.M.; Petrie, L.M.; Fraley, S.K. (Oak Ridge National Lab., TN). Dec 1984. NTIS, PC A99/MF A01. File Number TI85007576. (ORNL/NUREG/CSD—2/Vol.2). Contract W-7405-ENG-26.

In SCALE: a modular code system for performing standardized computer analyses for licensing evaluation. Volume 2. Functional modules.

ICE-S is a cross-section mixing code which will accept cross sections from an AMPX working library and produce mixed cross sections in the AMPX working library format, ANISN format, the group-independent ANISN format and the Monte Carlo processed cross section library format. User input is in the free-form or fixed-form FIDO structure. The code is also operable as a module in the AMPX system. Subsections are: introduction, theory, program description, input, and sample problems.

30794 (NUREG/CR—0200-Vol.2, pp vp, Section F9) **MORSE-SGC/S for the SCALE system.** West, J.T.; Hoffman, T.J.; Emmett, M.B. (Oak Ridge National Lab., TN). Dec 1984. NTIS, PC A99/MF A01. File Number TI85007576. (ORNL/NUREG/CSD—2/Vol.2).

In SCALE: a modular code system for performing standardized computer analyses for licensing evaluation. Volume 2. Functional modules.

MORSE-SGC/S is the SCALE version of the MORSE-SGC code. This new version contains the supergroup cross-section storage and tracking feature of MORSE-SGC, along with a new improved geometry system (MARS, Multiple ArRay System) for nested rectangular array analysis. MROSE-SGC/S is written to solve a wide variety of shielding and criticality problems without user-required subroutines. Subsections are: introduction, theory, input, program description, and sample problems.

30795 (NUREG/CR—0200-Vol.2, pp vp, Section F11) **KENO V.a: an improved Monte Carlo criticality program with supergrouping.** Petrie, L.M.; Landers, N.F. (Oak Ridge National Lab., TN). Dec 1984. NTIS, PC A99/MF A01. File Number TI85007576. (ORNL/NUREG/CSD—2/Vol.2).

In SCALE: a modular code system for performing standardized computer analyses for licensing evaluation. Volume 2. Functional modules.

KENO V.a is an extension of the KENO-V Monte Carlo criticality program and was developed for use in the SCALE system. In addition to the features available in KENO V, KENO V.a offers versatile new geometry capabilities and in-line printer plots of the geometry. The new geometry features include (1) the array of arrays option, (2) the holes option, and (3) variable chords for hemicylinders and hemispheres. The array of arrays options allows arrays to be built of other arrays and nested to any depth, subject to the availability of sufficient computer memory. The holes option allows the placement of one or more geometry regions within other geometry regions. The depth of hole nesting is limited only be the availability of sufficient computer memory. The variable chords option allows a hemisphere or hemicylinder to be as small as non-existent or as large as a full sphere or cylinder, or any size in between. The primary purpose of KENO V.a is to determine k-effective. Other calculated quantities include lifetime and generation time, energy-dependent leakages, energy- and region-dependent absorptions, fissions, fluxes, and fission densities. KENO V.a retains the KENO V features. This advanced user-oriented program features simplified data input and efficient use of computer storage.

30796 (NUREG/CR—0200-Vol.3) **SCALE: a modular code system for performing standardized computer analyses for licensing evaluation. Volume 3. Miscellaneous.** (Oak Ridge National Lab., TN (USA)). Dec 1984. Contract AC05-84OR21400. 493p. (ORNL/NUREG/CSD—2/Vol.3). NTIS, PC A21/MF A01 - GPO. File Number TI85007581.

This manual provides documentation for a new, multi-faceted computational system called SCALE (Standardized Computer Analyses for Licensing Evaluation) that has been developed to provide a standard analysis tool for use by the NRC staff and licensees in evaluating nuclear fuel facility and package designs. The SCALE system consists of several automated analytical sequences (control modules) which perform criticality, shielding, and/or heat transfer calculations with a minimum of user-required input. The computer codes (functional modules) used within each analytical sequence can also be run in a stand-alone fashion or coupled together in a sequence determined by the user. Volume 3 describes various libraries, input systems, and guides for use with the SCALE System; separate abstracts are provided for each.

30797 (NUREG/CR—0200-Vol.3, pp vp, Section M2) **SCALE system driver.** Petrie, L.M. (Oak Ridge National Lab., TN). Dec 1984. NTIS, PC A21/MF A01 - GPO. File Number TI85007581. (ORNL/NUREG/CSD—2/Vol.3). Contract W-7405-ENG-26.

In SCALE: a modular code system for performing standardized computer analyses for licensing evaluation. Volume 3. Miscellaneous.

The SCALE driver was designed to allow implementation of a modular code system consisting of control modules, which determine the calculation path, and functional modules, which perform the basic calculations. The user can either select a control module and have that module determine the execution path, or the user can select functional modules directly by input.

30798 (NUREG/CR—0200-Vol.3, pp vp, Section M2) **SCALE subroutine library.** Petrie, L.M. (Oak Ridge National Lab., TN). Dec 1984. NTIS, PC A21/MF A01 - GPO. File Number TI85007581. (ORNL/NUREG/CSD—2/Vol.3). Contract W-7405-ENG-26.

In SCALE: a modular code system for performing standardized computer analyses for licensing evaluation. Volume 3. Miscellaneous.

The SCALE subroutine library is a collection of subroutines, each of which performs a function which may be useful to more than a single program. These subroutines have been collected into a library so that a program can easily access those it needs. In the description that follows the calling sequence, a brief description of the function, a brief description of the arguments, and the programming language used for each subroutine in the library is given. This section is written from the point of view of aiding a programmer in using these subroutines in a program.

30799 (NUREG/CR—0200-Vol.3, pp vp, Section M3) **SCALE free-form reading routines.** Petrie, L.M. (Oak Ridge National Lab., TN). Dec 1984. NTIS, PC A21/MF A01 - GPO. File Number TI85007581. (ORNL/NUREG/CSD—2/Vol.3). Contract W-7405-ENG-26.

In SCALE: a modular code system for performing standardized computer analyses for licensing evaluation. Volume 3. Miscellaneous.

A set of free-form data reading routines has been developed to facilitate the use of free-formatted data input. These routines are used by the control programs to read the standard composition data and related data. Some of the functional modules such as KENO V and HEATING6 also make extensive use of these routines. This document is intended to provide guidance to a programmer desiring to use these routines in a program. Section M3.2 explains the conventions used to input data, and Section M3.3 contains information necessary for a programmer to use the routines.

30800 (NUREG/CR—0200-Vol.3, pp vp, Section M8) **Standard composition library.** Bucholz, J.A.; Knight, J.R.; Parks, C.V.; Petrie, L.M.; Turner, J.C.; Westfall, R.M. (Oak Ridge National Lab., TN). Dec 1984. NTIS, PC A21/MF A01 - GPO. File Number TI85007581. (ORNL/NUREG/CSD—2/Vol.3).

In SCALE: a modular code system for performing standardized computer analyses for licensing evaluation. Volume 3. Miscellaneous.

The Standard Composition Library has been included within the SCALE system to provide the user with a simple and straightforward method of specifying the material mixtures for a given problem. The library consists of over 200 mixtures and isotopes commonly used within shielding and criticality problems. This library is tabulated in Section M8.2 with the various features of each composition. Additionally, a number of standard fissile solutions available for use are tabulated in Section M8.3. The user is also able to specify the isotopic distribution of boron, uranium, or plutonium by using the table provided in Section M8.4.

30801 (NUREG/CR—0200-Vol.3, pp vp, Section M9) **MARS: a multiple array system using combinatorial geometry.** West, J.T.; Emmett, M.B. (Oak Ridge National Lab., TN). Dec 1984. NTIS, PC A21/MF A01 - GPO. File Number TI85007581. (ORNL/NUREG/CSD—2/Vol.3).

In SCALE: a modular code system for performing standardized computer analyses for licensing evaluation. Volume 3. Miscellaneous.

MARS is a combinatorial geometry method for modeling a Multiple ARray System. It allows the user the ability to model many unique rectangular arrays with unlimited array nesting. In this system, arrays may contain arbitrary vacancies and may be arbitrarily positioned in space. Geometry may be modeled around an array and optionally repeated with the array. Array repetition and array nesting does not require additional computer memory, hence MARS can model very complicated geometry systems with a minimum of computer memory requirements.

30802 (NUREG/CR—0200-Vol.3, pp vp, Section M10) **FIDO input system.** Petrie, L.M. (Oak Ridge National Lab., TN). Dec 1984. NTIS, PC A21/MF A01 - GPO. File Number TI85007581. (ORNL/NUREG/CSD—2/Vol.3). Contract W-7405-ENG-26.

In SCALE: a modular code system for performing standardized computer analyses for licensing evaluation. Volume 3. Miscellaneous.

This document provides a description of the FIDO input system being used in conjunction with several SCALE functional modules. The FIDO system is a widely used method of entering or modifying large data arrays with minimum effort. Special advantage is taken of patterns of repetition or symmetry whenever possible.

30803 (NUREG/CR—0200-Vol.3, pp vp, Section M11) **SCALE interactive input processor.** Knight, J.R. (Oak Ridge National Lab., TN). Dec 1984. NTIS, PC A21/MF A01 - GPO. File Number TI85007581. (ORNL/NUREG/CSD—2/Vol.3). Contract W-7405-ENG-26.

In SCALE: a modular code system for performing standardized computer analyses for licensing evaluation. Volume 3. Miscellaneous.

The purpose of the SCALE Interactive Input Processor is to assist the user who wishes to enter the data needed to run a job from a terminal connected to the DEC-10 computer at Oak Ridge National Laboratory. Prompting messages for each section of data are followed by an opportunity to reenter the data if errors are found. Section M11.2 lists the subroutine names and briefly describes the purpose of each one. Section M11.3 lists the prompting messages and gives a description of the expected user response following each message. Section M11.4 describes how a problem is submitted for execution when all of the data has been entered.

30804 (NUREG/CR—0200-Vol.3, pp vp, Section M12) **CESAR: a criticality experiment storage and retrieval program.** Knight, J.R.; Westfall, R.M. (Oak Ridge National Lab., TN). Dec 1984. NTIS, PC A21/MF A01 - GPO. File Number TI85007581. (ORNL/NUREG/CSD—2/Vol.3).

In SCALE: a modular code system for performing standardized computer analyses for licensing evaluation. Volume 3. Miscellaneous.

CESAR is a program for storing and retrieving input data for criticality calculations using the SCALE system. Each problem consists of a problem description and an input data set to run the problem. Editing and updating features are described. As of January 1984, 447 experiments were included in the CESAR library.

30805 (NUREG/CR—0200-Vol.3, pp vp, Section M13) **PICTURE: a printer plot package for making 2-D pictures of MARS geometries.** Emmett, M.B. (Oak Ridge National Lab., TN). Dec 1984. NTIS, PC A21/MF A01 - GPO. File Number TI85007581. (ORNL/NUREG/CSD—2/Vol.3).

In SCALE: a modular code system for performing standardized computer analyses for licensing evaluation. Volume 3. Miscellaneous.

The PICTURE program was written to provide aid in preparing correct input data for the MARS geometry package which is a multiple array system using combinatorial geometry. It provides a printed view of arbitrary two-dimensional slices through the geometry. By inspecting these pictures one may determine if the geometry specified by the input cards is indeed the desired geometry. This report describes PICTURE, its options, and input.

30806 (NUREG/CR—0200-Vol.3, pp vp, Section M14) **COMPOZ data guide.** Knight, J.R. (Oak Ridge National Lab., TN). Dec 1984. NTIS, PC A21/MF A01 - GPO. File Number TI85007581. (ORNL/NUREG/CSD—2/Vol.3).

In SCALE: a modular code system for performing standardized computer analyses for licensing evaluation. Volume 3. Miscellaneous.

The COMPOZ Data Guide used to create the Standard Composition Library is described. Of particular importance is documentation of the COMPOZ input data file structure. Knowledge of the file structure allows users to edit the data file and subsequently create their own site-specific composition library.

30807 **(RRC—57) Variational-modal expansion method for space-time kinetics.** Srinivasan, L. (Reactor Research Centre, Kalpakkam (India)). 1982. 18p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85900958.

A new numerical approach has been developed to solve the time dependent multi-group diffusion equation using variational-modal expansion method. In this method the neutron flux is expanded in series with the time part in the form of an exponential which is derived from the solution of space-time diffusion equations by iterative techniques. For the space part the variational approach is used to get an appropriate functional and by integration over the spatial co-ordinates, a set of algebraic equations are derived from which the solution could be obtained. A sample problem in one-dimensional slab geometry has proved the efficiency of the method.

30808 **(RRC—58) Activity report of Reactor Physics Section, 1982.** Reddy, C.P. (ed.). (Reactor Research Centre, Kalpakkam (India)). 1983. 91p. NTIS (US Sales Only), PC A05/MF A01. File Number DE85900959.

With the commissioning of Honeywell-DPS-8 computer system at RRC during March 1982, all the computer codes earlier being run on the IBM-370 computer at IIT, Madras, were adapted and tested on the local computer. In addition to the work reported in the sections on Nuclear Data, Fast Reactor Design Studies, Safety Analysis and Shielding Design, a new section on Reactor Noise Analysis has been added in this report to bring out the detailed studies taken up in this area. A national Workshop on Reactor Noise Analysis is being organized during February 23-24, 1983 at Reactor Research Centre to bring together active workers in this area, from various laboratories. Some of the studies in Statistical Physics which will find applications in Monte Carlo Techniques being developed in our group are also reported in a separate section. A list of publications made by the members of the section, along with the staff chart of the Reactor Physics Section are given at the end of this report.

30809 **(RRC—64) Activity report of Reactor Physics Section, 1983.** Murthy, K.P.N. (ed.). (Reactor Research Centre, Kalpakkam (India)). 1984. 120p. NTIS (US Sales Only), PC A06/MF A01. File Number DE85900952.

The preliminary physics design of a 500 MWe, Prototype Fast Breeder Reactor (PFBR) including the neutronics, shielding and safety analysis was completed during this year and the results have been incorporated in the Preliminary Feasibility and Design Report for PFBR. Neutronics studies of a small carbide fuelled core and nominal carbide core were also carried out during this period. The 36 contributions included in this report cover the different activities viz. Nuclear Data Processing and Testing, Reactor Theory, Design and Analysis, Reactor Kinetics and Safety Analysis, Reactor Noise Analysis, Radiation Transport and Shielding; and Statistical Physics. It is evident from the above contributions that the activities of the section are oriented not only towards the nuclear design needs of FBTR and PFBR, but also in studying some of the current problems in Reactor Theory, Radiation Transport, Reactor Safety, etc. A laboratory for reactor physics and shielding experiments is being set up for FBTR and PFBR.

2202 Components And Accessories

REFER ALSO TO CITATION(S) 30840, 30865, 30866, 30867, 30868, 30869, 30875, 31472

30810 **(AECL—8190) Analysis of flow-induced vibration of heat exchanger and steam generator tube bundles using the AECL computer code PIPEAU-2.** Gorman, D.J. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Dec 1983. 10p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85701241.

PIPEAU-2 is a computer code developed at the Chalk River Nuclear Laboratories for the flow-induced vibration analysis of heat exchanger and steam generator tube bundles. It can perform this analysis for straight and 'U' tubes. All the theoretical work underlying the code is analytical rather than numerical in nature. Highly accurate evaluation of the free vibration frequencies and mode shapes is therefore obtained. Using the latest experimentally determined parameters available, the free vibration analysis is followed by a forced vibration analysis. Tube response due to fluid turbulence and vortex shedding is determined, as well as critical fluid velocity associated with fluid-elastic instability.

30811 **(CEA-CONF—7537) Qualification rules of important electrical equipments for safety.** Le Meur, M.; Henry, J.Y. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete). May 1984. 13p. (In French). (CONF-840516—9; DAS—82). NTIS (US Sales Only), PC A02/MF A01. File Number DE85751315.

From International symposium on aging in tests of safety equipment for nuclear power plants; Paris, France (15 May 1984).

This presentation defines different categories of safety related electrical equipments and the correspondant qualification test programs.

30812 (IAEA-TC—427/5, pp 216-223) **Transition from single-phase forced convection to fully developed boiling.** Maroti, L. (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). Jul 1984. NTIS (US Sales Only), PC A14/MF A01. File Number TI. (CONF-8310369—; TC-SR—3).

From Specialists' meeting on experimental and modelling aspects of small-break LOCA; Budapest, Hungary (3 Oct 1983).

An advanced computer code for the complete analysis of a complex thermal-hydraulic system should be capable to calculate a number of heat transfer regimes. The correlations for the calculation of wall heat transfer do not perfectly predict the true physical process and they cannot ensure smooth transition at the boundaries of the individual regimes of heat transfer. It often happens that expressions for two adjacent regions supply different values for the heat transfer coefficient at the boundary. The discontinuity of the wall heat transfer functions can easily lead to numerical problems or result in inaccuracy of the calculations. Examples are given of how the problem of wall heat transfer is handled in some widely used codes (TRAC, DRUFAN, RELAP5) and a new solution is explained for the case of partial boiling heat transfer which ensures smooth transition at the boundaries.

30813 (NUREG/CR—3855-6-84) **Characterization of nuclear reactor containment penetrations. Preliminary report.** Bump, T.R.; Seidensticker, R.W.; Shackelford, M.A.; Gambhir, V.K.; McLennan, G.L. (Argonne National Lab., IL (USA)). Jun 1984. Contract AC04-76DP00789;W-31-109-ENG-38. 273p. (SAND—84-7139-6-84; ANL—84-33). NTIS, PC A12/MF A01 - GPO. File Number TI85000657.

This report summarizes the survey work conducted by Argonne National Laboratory on the design and details of major penetrations in 22 nuclear power plants. The survey includes all containment types and materials in current use. It also includes details of all types of penetrations (except for electrical penetration assemblies and valves) and the seals and gaskets used in them. The report provides a test matrix for testing major penetrations and for testing seals and gaskets in order to evaluate their leakage potential under severe accident conditions.

30814 (NUREG/CR—4263) **Reliability analysis of stiff versus flexible piping. Final project report.** Lu, S.C.; Chou, C.K. (Lawrence Livermore National Lab., CA (USA)). May 1985. Contract W-7405-ENG-48. 76p. (UCRL—20410). NTIS, PC A05/MF A01 - GPO. File Number TI85012990.

This research project is to develop a technical basis for flexible piping designs which will improve piping reliability and minimize the use of pipe supports, snubbers, and pipe whip restraints. This study indicated that piping design can be made more reliable by some reduction of rigid supports and/or snubbers. This study also confirmed that the malfunction of pipe whip restraints introduced higher thermal stresses and tended to reduce the overall piping reliability. Finally, our results indicated that supports in a flexible piping design may need to be reevaluated and that the elimination of pipe supports which are close to components should be done with care in order to minimize the impact on the component reliability.

30815 (WAPD-T—2851) **Automatic capability to store and retrieve component data and to calculate structural integrity of these components.** McKinnis, C.J.; Toor, P.M. (Bettis Atomic Power Lab., West Mifflin, PA (USA)). Jan 1985. Contract AC11-76PN00014. 15p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85012429.

In structural analysis, assimilation of material, geometry, and service history input parameters is very cumbersome. Quite often with changing service history and revised material properties and geometry, an analysis has to be repeated. To overcome the above mentioned difficulties, a computer program was developed to provide the capability to establish a computerized library of all material, geometry, and service history parameters for components. The program also has the capability to calculate the structural integrity based on the Arrhenius type equations, including the probability calculations. This unique combination of computerized input information storage and automated analysis procedure assures consistency, efficiency, and accuracy when the hardware integrity has to be reassessed.

30816 (CE-Trans—7726) **Non-linear mathematical model of the dynamics of a turbine for saturated steam.** Miller. A.; Lewandowski, J. (Central Electricity Generating Board, London (UK). Translations Section). 1982. Translation source information not available . (CONF-7905243—1-Trans.). 22p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85901436.

From Conference on steam turbines for nuclear power plants; Plzen, Czechoslovakia (15 May 1979).

The paper presents a nonlinear mathematical model of the dynamics of a turbine for saturated steam installed at a nuclear power station. The model enables an analysis to be made of the transient processes in the turbine flow section caused by various external disturbances. The concept and structure of the model for a typical construction are shown. The relationships describing mass and energy storage processes, as well as the properties of the turbine flow section components are presented. The model is given in the form of a set of differential equations, ordinary, nonlinear and nonlinear algebraic equations. The method of finding a solution to the model is discussed, and results of calculations for turbine overspeed and sudden increase in inlet pressure are given.

2203 Fuel Elements

REFER ALSO TO CITATION(S) 31782

30817 (AEEW-M—2103) **Particle size distribution of fragmented melt debris from Molten Fuel Coolant Interactions.** Fletcher, D.F. (UKAEA Atomic Energy Establishment, Winfrith). Apr 1984. 23p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85701243.

Results are presented of a study of the types of statistical distributions which arise when examining debris from Molten Fuel Coolant Interactions. The lognormal probability distribution and the modifications of this distribution which result from the mixing of two distributions or the removal of some debris are described. Methods of fitting these distributions to real data are detailed. A two stage fragmentation model has been developed in an attempt to distinguish between the debris produced by coarse mixing and fine scale fragmentation. However, attempts to fit this model to real data have proved unsuccessful. It was found that the debris particle size distributions from experiments at Winfrith with thermite generated uranium dioxide/molybdenum melts were Upper Limit Lognormal.

30818 (AEEW-M—2107) **Preliminary results from film boiling destabilisation experiments.** Naylor, P. (UKAEA Atomic Energy Establishment, Winfrith). May 1984. 32p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85701244.

A series of experiments to investigate the triggered destabilisation of film boiling has been undertaken. Film boiling was established on a polished brass rod immersed in water and the effects of various triggers were investigated. Preliminary results are presented and two thresholds have been observed: an impulse threshold below which triggered destabilisation will not occur and a thermal threshold above which film boiling will re-establish following triggered destabilisation.

30819 (CONF-850536—4) **Analysis of transient fission gas release and swelling in oxide fuel.** Gruber, E.E. (Argonne National Lab., IL (USA)). 1985. Contract W-31-109-ENG-38. 22p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85012367.

From American Ceramic Society annual meeting; Cincinnati, OH, USA (5 May 1985).

Calculations of fission-gas behavior have been carried out with an updated version of the FRAS3 code for the FGR-40 series of transient tests of irradiated PNL-10 fuel. This same series of tests was used in an earlier evaluation study with a preliminay version of the code. While that study provided positive support for the modeling approach, it also indicated deficiencies in some areas. Although a number of improvements have been implemented in the current version of the code, this study examines the effect of an explicit treatment of bubble growth within the grains, including the effect of vacancy depletion caused by the competition of overpressured bubbles for available vacancies. The result is a reduction by as much as 90% in the predicted swelling, accompanied by an increase in transfer of gas from the grains to boundaries. Both swelling and gas release predictions are brought into much better agreement with the observed values.

30820 (IA—1404, pp 121) **Fractography of irradiated nuclear fuel elements.** Munitz, A.; Livne, Z.; Carlos, C. Jul 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85780940.

Published in summary form only.

In Research laboratories annual report 1983.

30821 (ORNL/CSD—78/R1) DEPTH-CHARGE static and time-dependent perturbation/sensitivity system for nuclear reactor core analysis. Revision I. White, J.R. (Oak Ridge National Lab., TN (USA)). Apr 1985. Contract AC05-84OR21400. 169p. NTIS, PC A08/MF A01. File Number DE85013103.

This report provides the background theory, user input, and sample problems required for the efficient application of the DEPTH-CHARGE system - a code black for both static and time-dependent perturbation theory and data sensitivity analyses. The DEPTH-CHARGE system is of modular construction and has been implemented within the VENTURE-BURNER computational system at Oak Ridge National Laboratory. The DEPTH module (coupled with VENTURE) solves for the three adjoint functions of Depletion Perturbation Theory and calculates the desired time-dependent derivatives of the response with respect to the nuclide concentrations and nuclear data utilized in the reference model. The CHARGE code is a collection of utility routines for general data manipulation and input preparation and considerably extends the usefulness of the system through the automatic generation of adjoint sources, estimated perturbed responses, and relative data sensitivity coefficients. Combined, the DEPTH-CHARGE system provides, for the first time, a complete generalized first-order perturbation/sensitivity theory capability for both static and time-dependent analyses of realistic multidimensional reactor models. This current documentation incorporates minor revisions to the original DEPTH-CHARGE documentation (ORNL/CSD-78) to reflect some new capabilities within the individual codes.

30822 Manufacturing process to reduce large grain growth in zirconium alloys. Rosecrans, P.M. (to Dept. of Energy). US Patent Application 6-636,659. 1 Aug 1984. 11p. Contract AC12-76SN00052.

It is an object of the present invention to provide a procedure for desensitizing zirconium-based alloys to large grain growth (LGG) during thermal treatment above the recrystallization temperature of the alloy. It is a further object of the present invention to provide a method for treating zirconium-based alloys which have been cold-worked in the range of 2 to 8% strain to reduce large grain growth. It is another object of the present invention to provide a method for fabricating a zirconium alloy clad nuclear fuel element wherein the zirconium clad is resistant to large grain growth.

2204 Control Systems

REFER ALSO TO CITATION(S) 30858

30823 (CONF-850468—1) Application of microprocessor based controller in the Breeder Reactor Program. Messick, N.C. Lukas, M.P. (Argonne National Lab., Idaho Falls, ID (USA); Bailey Controls Co., King of Prussia, PA (USA)). 1985. Contract W-31-109-ENG-38. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85009705.

From Seminar on power plant digital control applications; Phoenix, AZ, USA (9 Apr 1985).

This paper treats Argonne National Laboratory's experience using microprocessor based controllers presently in use on several control loops within the EBR-II reactor facility as well as tests being performed by these controllers. Also included is a discussion of the expandability, modularity, range of capabilities and higher level functions possible using such equipment.

30824 (CRN-CPR—83-11) Study, realization and tests of a simulator reactimeter system at high dynamics. Mahmood, Z. (Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires). 1983. 207p. (In French). NTIS (US Sales Only), PC A10/MF A01. File Number DE85751326.

An electronic device has been performed for the determination of the reactivity on a nuclear reactor. This reactivity meter is able to make on line measurements. One of the main characteristics of this system which has been achieved with analog circuits, is the large dynamic scale of measurement. This device allowed us to determine the reactivity for different core configurations of the Strasbourg Reactor.

30825 (ITEF—168(1983)) Data acquisition system for a calorimetric installation. Artamonov, A.A.; Gorbunov, P.A.; Kornelyuk, Yu.G.; Savitskij, M.M.; Ehpshtejn, V.Sh. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1983. 44p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. File Number DE85701119.

Data acquisition system for a calorimeter with a fine structure is described. The structure and purpose of the main and service programs of the system are considered. The description of the service programs is provided in the form of manual for users. The system operates on-line with the ES-1O10 minicomputer and ensures control and adjustment of physical equipment, data readout, monitoring, preliminary processing, filtration and packing, data recording on a magnetic tape, control of the measurement period and a number of other auxiliary functions.

30826 (JAERI-M—83-187) Development of two-dimensional transient fuel behavior analysis code for non-concentric pellet-cladding alignments, NSR-EXENT. Analysis model and sample calculation. Fujishiro, Toshio; Shirakawa, Noriyuki; Tsuruta, Takaharu. (Japan Atomic Energy Research Inst., Tokyo). Nov 1983. 65p. (In Japanese). NTIS (US Sales Only), PC A04/MF A01. File Number DE85701122.

Two-dimensional transient fuel behavior analysis code "NSR-EXENT" has been developed as a sub-program of NSR-77 in order to analyze local heat transfer effects. This code deals with local effects such as circumferential variation of gap conductance caused by fuel pellet eccentricity and the local cooling by cladding surface thermocouples. The local variation of heat generation by the Zircaloy-water reaction and that of pellet-cladding fixation by the UO_2-Zircaloy eutectic formation have also been incorporated in the model. This report describes the analysis model of NSR-EXENT and the results of sample calculations.

30827 (WH-Trans—508) New surveillance and control techniques and their application to nuclear power plant with particular reference to 1300 MW. Carpentier, L.; Cormault, P. Translated from *Revue Generale Nucleaire* ; No. 3, 218-229(1980). 30p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85900124. DE85900124

Summaries of papers are presented concerning the surveillance and control of nuclear power stations. The simultaneous presentation by many French manufacturers of equipment intended to accomplish the various functions has doubtless underlined their efforts to create new products, but has also made it possible to bring into prominence certain common lines; in following these they have chosen the appropriate technique and technology. The development of large nuclear power stations has, under the impetus of EDF helped to clarify certain aspects relating to equipment schedules. This is why M. Bacher has first mentioned both the proposed French nuclear program and the requirements of quality, timescales and costs which the nuclear power plant must satisfy.

2205 Environmental Aspects

REFER ALSO TO CITATION(S) 29908, 30670, 32167

30828 (DOE/PN/00292—T5) Beaver Valley Power Station and Shippingport Atomic Power Station. 1984 Annual environmental report, radiological. Volume 2. (Duquesne Light Co., Pittsburgh, PA (USA)). [1985]. Contract AC11-76PN00292. 127p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE85011534.

This report describes the Radiological Environmental Monitoring Program conducted during 1984 in the vicinity of the Beaver Valley Power Station and the Shippingport Atomic Power Station. The Radiological Environmental Program consists of on-site sampling of water and gaseous effluents and off-site monitoring of water, air, river sediments, soils, food pathway samples, and radiation levels in the vicinity of the site. This report discusses the results of this monitoring during 1984. The environmental program outlined in the Beaver Valley Power Station Technical Specifications was followed throughout 1984. The results of this environmental monitoring program show that Shippingport Atomic Power Station and Beaver Valley Power Station operations have not adversely affected the surrounding environment. 23 figs., 18 tabs.

30829 (LPA-P—1) Sizewell 'B' public inquiry. Proof of evidence on local environmental issues. Barritt, E.E. (Suffolk County Council, Ipswich (UK); Suffolk Coastal District Council, Woodbridge (UK)). Nov 1982. 46p. British Library Lending Division, Boston Spa, Wetherby, LS23 7BQ.

The report falls under the headings: introduction (need/economics; safety; waste management; local and site specific issues); the Sizewell site - history and planning policies; planning and environmental implications; land use and landscape implications; ecological implications; mineral requirements; highway implications; employment implications; accommodation implications; infrastructure and social/community services; safeguarding restrictions for Sizewell - Nuclear Installations Inspectorate; decommissioning.

30830 (NUCLEBRAS-CDTN—456) Meteorological instrumentation for nuclear installations. Costa, A.C.L. da. (Centro de Desenvolvimento da Tecnologia Nuclear, Belo Horizonte (Brazil)). 1983. 111p. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. File Number DE85701465.

The main requirements of regulatory agencies, concerning the meteorological instrumentation needed for the licensing of nuclear facilities are discussed. A description is made of the operational principles of sensors for the various meteorological parameters and associated electronic systems. Finally, it is presented an analysis of the problems associated with grounding of a typical meteorological station.

30831 (NUREG—1033) Final Environmental Statement related to the operation of WPPSS Nuclear Project No. 3 (Docket No. 50-508). (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). May 1985. 253p. NTIS, PC A12/MF A01. File Number TI85901475.

This Final Environmental Statement contains the second assessment of the environmental impact associated with the Washington Public Power System Nuclear Project No. 3 (WNP-3) pursuant to the National Environmental Policy Act of 1969 (NEPA) and Title 10 of the Code of Federal Regulations, Part 51, as amended, of the Nuclear Regulatory Commission regulations. This statement examines the environment, environmental consequences and mitigating actions, and environmental benefits and costs. Land use and terrestrial and aquatic resource impacts will be small. Operational impacts to historic and archeological sites will be negligible. The effects of routine operations, energy transmission and periodic maintenance of rights-of-way and transmission facilities should not jeopardize any populations of endangered or threatened species. No significant impacts are anticipated from normal operational releases of radioactivity. The risk of radiation exposure associated with accidental release of radioactivity is very low. The net socioeconomic effects of the project will be beneficial.

30832 (NUREG—1085) Final Environmental Statement related to the operation of Nine Mile Point Nuclear Station, Unit No. 2 (Docket No. 50-410). (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). May 1985. 373p. NTIS, PC A16/MF A01 - GPO. File Number TI85901424.

This Final Environmental Statement contains the assessment of the environmental impact associated with the operation of the Nine Mile Point Nuclear Station, Unit 2, pursuant to the National Environmental Policy Act of 1969 (NEPA) and Title 10 of the Code of Federal Regulations, Part 51, as amended, of the Nuclear Regulatory Commission regulations. This statement examines the environment, environmental consequences and mitigating actions, and environmental and economic benefits and costs.

30833 (UCID—20413-Vol.2) SMACS - a system of computer programs for probabilistic seismic analysis of structures and subsystems. Volume II. Example problem. Maslenikov, O.R.; Johnson, J.J.; Tiong, L.W.; Mraz, M.J.; Bumpus, S.; Gerhard, M.A. (Lawrence Livermore National Lab., CA (USA)). Mar 1985. Contract W-7405-ENG-48. 375p. NTIS, PC A16/MF A01; 1; GPO Dep. File Number DE85011842.

In this volume of the SMACS User's Manual an example problem is presented to demonstrate the type of problem that SMACS is capable of solving and to familiarize the user with format of the various data files involved. This volume is organized into thirteen appendices which follow a short description of the problem. Each appendix contains listings of the input and output files associated with each computer run that was necessary to solve the problem. In cases where one SMACS program uses data generated by another SMACS program, the data file is shown in the appendix for the programs which generated it.

2206 Research, Test, And Experimental Reactors

REFER ALSO TO CITATION(S) 30825, 30859, 30971, 30972, 30991

30834 (AECL—8252) Slowpoke: the first decade and beyond. Hilborn, J.W.; Burbidge, G.A. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Oct 1983. 19p. (CONF-831012—14). NTIS (US Sales Only), PC A02/MF A01. File Number DE85701504.

From International symposium on use and development of low and medium flux research reactors; Cambridge, MA, USA (17 Oct 1983).

Since the startup of the first SLOWPOKE reactor at Chalk River Nuclear Laboratories in 1970, six SLOWPOKE-2 research reactors have been installed at other locations in Canada and a seventh is nearing completion in Jamaica. Designed mainly for neutron activation analysis, the 20 KW SLOWPOKE produces a thermal neutron flux of 10^{12} n.cm^{-2}s^{-1} at five sample sites in a beryllium reflector surrounding the core. There are an additional five sites in the water reflector outside the beryllium. It has a high degree of inherent safety, arising from the negative temperature and void coefficients of the core, limited maximum excess reactivity, and restricted access to the core by users. As a result the reactor does not require an automatic shutdown system, neutron ionization chambers or low power startup instruments. Automatic control is exercised by a single motor-driven absorber rod responding to a self-powered neutron detector. Once operating, the reactor is licensed to be left unattended, but remotely monitored, for periods up to 24 hours. Because the reactor is so simple and safe, users of the facility can be licensed as operators without formal training in reactor technology. They must, of course, be fully qualified in radiation protection procedures. Reactor users do not have access to the core and are not permitted to store enriched uranium fuel at the reactor site. Present work at the Chalk River Nuclear Laboratories is directed toward the conversion of future SLOWPOKE reactors to low-enriched fuel, in support of an international effort to prevent the possible diversion and misuse of highly-enriched uranium. The feasibility of uprating SLOWPOKE to 2 MWt for heating buildings is also being studied.

30835 (BARC—1231) Measurement of fast neutron flux profile across the inner face of the MAPP-1 end-shield during reactor commissioning. Dravid, H.K.; Mehta, S.L.; Potti, S.T.; Jindal, R.N.; Deniz, V.C. (Bhabha Atomic Research Centre, Bombay (India). Experimental Reactor Physics Section). 1984. 23p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85900981.

Surveillance samples for studying radiation embrittlement of end-shield material, along with the fast neutron fluence monitors, have been introduced for irradiation in various optical sight plugs of RAPS-1, RAPS-2 and MAPP-1 end-shields. These optical sight plugs are located in the peripheral regions of the end-shields and do not correspond to the maximum damage locations, which would be near the axis of the reactor core. The fast neutron flux would fall substantially as one moves from the central to the peripheral points of the end-shield. For carrying out radiation embrittlement correlation at these locations the ratio of the fast flux at or near maximum

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damage point to the fast flux at the optical sight plugs is required. The above ratio in the region of the air-gap between the end-shield and the calandria was measured during the MAPP-1 commissioning by loading fast neutron flux monitors between fuel pellets in fuel bundles of channels L-10 and T-10, as well as in optical sight plugs, in such a way that all the monitors were in the plane of the inner face of the south end-shield and were irradiated simultaneously during a single reactor run. The channel L-10 is one of the four channels nearest to the axis of the calandria. The average fast flux in the outer ring of L-10 bundle to the average fast flux in the bottom optical sight plug was found to be 30.

30836 (CONF-850410—46) SASSYS-1 computer code verification with EBR-II test data. Warinner, D.K.; Dunn, F.E. (Argonne National Lab., IL (USA)). 1985. Contract W-31-109-ENG-38. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85012119.

From ANS/ENS fast reactor safety meeting; Knoxville, TN, USA (21 Apr 1985).

The EBR-II natural circulation experiment, XX08 Test 8A, is simulated with the SASSYS-1 computer code and the results for the latter are compared with published data taken during the transient at selected points in the core. The SASSYS-1 results provide transient temperature and flow responses for all points of interest simultaneously during one run, once such basic parameters as pipe sizes, initial core flows, and elevations are specified. The SASSYS-1 simulation results for the EBR-II experiment XX08 Test 8A, conducted in March 1979, are within the published plant data uncertainties and, thereby, serve as a partial verification/validation of the SASSYS-1 code.

30837 (DOE/NE/32123—T1) Development of improved thermoelectric materials for space nuclear power systems. Sixth technical progress report, March 1985. (General Electric Co., Philadelphia, PA (USA). Space Systems Div.). 1985. Contract AC01-84NE32123. 35p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85013079.

The program consists of two main tasks encompassing (1) the development of an improved SiGe alloy and (2) the development of an as yet unspecified advanced material intended to have superior performance characteristics when compared to SiGe alloys. Significant progress was made toward the goal of producing a SiGe based material with an improved figure-of-merit during this reporting period. In these studies, a quantitative evaluation of the characteristics which produce the low thermal conductivities observed in SiGe alloys is being developed. Specific areas of emphasis include the effects of grain size, charge carrier and GaP concentrations. An alternate method for alloying with GaP was evaluated in which the GaP was added to SiGe during the melting operation.

2207 Plutonium And Isotope Production Reactors

30838 (CONF-850507—14) Neutronic calculations for a new high flux reactor. Difilippo, F.C.; Worley, B.A.; Vondy, D.R. (Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 8p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85011551.

From International conference on nuclear data for basic and applied science; Santa Fe, NM, USA (13 May 1985).

The Oak Ridge National Laboratory has begun the design of a new high flux reactor to be used for basic research, isotope production, and material irradiation. One of the principal goals of the design is the production of a thermal flux peak in the reflector larger than $5 \times 10^{15}/cm^2sec$. A theoretical analysis of the slowing-down and diffusion of neutrons produced by a spherical fission source immersed in a moderator shows that the flux per unit power is maximized by combining a very undermoderated core with a very low absorbing reflector. The theoretical model interrelates total power, power density and transport properties with the thermal flux allowing very inexpensive scoping calculations. Full scale and detailed calculations were made with a numerical model which uses the Bold Venture code system. Calculations show that a highly enriched ^{235}U reactor with D_2O as moderator and reflector would produce the desired peak flux, and the reactor would have a reasonable core life.

2209 Reactor Safety

REFER ALSO TO CITATION(S) 31459, 31693, 32158, 32159, 32327

30839 (BMI—1984-052) Reliability analysis of crack propagation behavior of reactor components. Schaefer, R.; Schueller, G.I.; Kafka, P. (Bundesministerium des Innern, Bonn (Germany, F.R.); Industrieanlagen-Betriebsgesellschaft m.b.H., Ottobrunn (Germany, F.R.)). Nov 1984. 183p. (In German). NTIS (US Sales Only), PC A09/MF A01. File Number DE85751135.

A reliability analysis was carried out on a circumferential weld in the main coolant loop of a PWR with the aim of estimating the probability of a leak or break occurring in the planned life cycle of the plant. To get a basis for the reliability analysis the following influence factors were more closely examined: initial crack extent, load spectrum including the emergency earthquake situation and crack growth characteristics. For the actual reliability analysis a computer program was developed, which took the individual input data, in accordance with their statistical parameter, into account in a simulation calculation in line with the Monte Carlo Method. The Forman Formula was used to estimate the fatigue crack growth caused by the sequence of load events. The result was, that the fatigue crack growth, even in the case of large initial cracks, was negligibly small. The probability, that, in the case of very deep initial cracks, one-off high quasi-static load, e.g. during an earthquake, could cause a locally limited crack-through, was estimated to be about $5x10^{-6}$ in forty years.

30840 (BMI—1984-056) Comprehensive comparison of out-of-pile and in-pile bundle investigations on fuel rod deformation behavior during loss of coolant accidents. Chakraborty, A.K. (Bundesministerium des Innern, Bonn (Germany, F.R.); Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). Nov 1984. 65p. (In German). (GRS-A—945). NTIS (US Sales Only), PC A04/MF A01. File Number DE85751652.

Following the termination of single rod burst tests, both out-of-pile and in-pile bundle examinations with different design conditions and selection of parameters have been initiated and carried out at various places. A direct comparison of the results from the bundle tests becomes only possible with the knowledge of the details of tests. With the help of some common parameters the results of the bundle tests are compared and their influences on the relevance to LOCA are referred. The design parameters as well as those parameters selected as basis for a particular LOCA test, influence the experimental results, and play dominant parts for the evaluation of those results. For example, the existing thermohydraulics play a major part by influencing the ballooning of the cladding. The status up to the beginning of 1983 is considered in this report for comparative evaluation.

30841 (BMI—1984-057) Survey of materials and other problems of relevance in safety engineering, and an assessment of their reflection in regulatory guides for conventional and nuclear engineering (1. technical report). Trunk, M.; Herter, K.H. (Bundesministerium des Innern, Bonn (Germany, F.R.); Stuttgart Univ. (Germany, F.R.). Staatliche Materialpruefungsanstalt). Nov 1984. 93p. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE85751130.

Survey and assessment of nuclear engineering specifications and regulatory guides (ASME-BPVC Section III, division 1,2 and KTA, BS 5500) with regard to materials, dimensioning and testing for the purpose of showing to what extent available technical codes, regulatory guides and safety codes are useful in preventing failures and defining the safe limit. The other question examined is that of how these codes ought to be brought up to date in order to reflect the latest state of the art in science and technology.

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30842 (BMI—1984-064) Hydrogen Problems in Reactor Safety Research. Casper, H. (Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.); Bundesministerium des Innern, Bonn (Germany, F.R.)). Dec 1984. 230p. (In German). (CONF-8310382—; GRS-A—1020). NTIS (US Sales Only), PC A11/MF A01. File Number DE85751624.

From BMFT/BMI workshop on hydrogen problems in reactor safety research; Bonn, Germany (3 Oct 1983).

The BMFT and BMI have initiated a workshop 'Hydrogen Problems in Reactor Safety Research' that took place October 3./4., 1983. The objective of this workshop was to present the state of the art in the main areas - Hydrogen-Production - Hydrogen-Distribution - Hydrogen-Ignition - Hydrogen-Burning and Containment Behaviour - Mitigation Measures. The lectures on the different areas are compiled. The most important results of the final discussion are summarized as well.

30843 (BNL—36253) Probabilistic commentary: the rise and fall, and rise again, of risk assessment. Hendrie, J.M. (Brookhaven National Lab., Upton, NY (USA)). Feb 1985. Contract AC02-76CH00016. 15p. (CONF-850206—31). NTIS, PC A02/MF A01; GPO Dep. File Number DE85011817.

From International ANS/ENS topical meeting on probabilistic safety methods and applications; San Francisco, CA, USA (24 Feb 1985).

30844 (BNL-NUREG—35924) Relationship between regulatory issues and probabilistic risk assessments. Ilberg, D.; Papazoglou, I. (Brookhaven National Lab., Upton, NY (USA)). 1985. Contract AC02-76CH00016. 5p. (CONF-850610—22). NTIS, PC A02/MF A01 - GPO. File Number TI85007923.

From Annual meeting of the American Nuclear Society; Boston, MA, USA (9 Jun 1985).

The objective of this study was to obtain some perspective on the characteristics and the relative number of regulatory issues that are PRA related, i.e., can be effectively addressed by plant specific PRA studies. It was also aimed at developing approaches to resolution of regulatory issues as part of plant specific PRAs. Several ongoing NRC programs include a number of safety-related issues which are applicable to operating plants. A number of these issues include aspects that strongly interact with items addressed in PRA studies. The resolution of several generic issues using PRA studies has already started. A review of over 335 issues included in three NRC programs was conducted: Generic Issue Program (GI); Systematic Evaluation Program (SEP); and TMI Action Plan (TMI). The review identifid 240 items related to PRA, 120 of which were judged to have significant effect on core damage frequency. It is believed that these items can be effectively treated in a PRA study that includes internal and external events.

30845 (CONF-811042—11) Measurement of two-phase flow at the core upper plenum interface under simulated reflood conditions. Thomas, D.G.; Combs, S.K. (Oak Ridge National Lab., TN (USA)). 1981. Contract AC05-84OR21400. 17p. NTIS, PC A02 - GPO. File Number DE85004514.

From 9. water reactor safety research information meeting; Washington, DC, USA (26 Oct 1981).

The Instrument Development Loop (IDL) Program is part of the International 2D/3D Refill and Reflood Experimental and Research Program. The principal experimental facilities in the International Program are the Slab Core Experiment in Japan and the Upper Plenum Test Facility (UPTF) in Germany. Among the objectives of the International Program are: the study of the steam binding effect during reflood for various emergency core cooling combinations; the study of the reflood flow distribution (chimney effect) in a heated core; and the study of the flow hydrodynamics in the core, downcomer, and upper plenum during refill and reflood. A major problem is coupling the results to be obtained at the two major experiments. One approach is to measure the flows at the interface boundary of the two experiments and attempt to match them as closely as possible. Therefore the two major objectives of the IDL Program were to simulate expected flows at the core/upper plenum interface during the reflood phase of a postulated LOCA and to develop instrumentation systems for mass flow measurement at the core/upper plenum interface.

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30846 (CONF-850406—8) Behavior of aerosols in a steam-air environment. Adams, R.E.; Tobias, M.L.; Longest, A.W. (Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 18p. NTIS, PC A02/MF A01 - GPO. File Number TI85011422.

From International symposium and workshop on particulate and multi-phase processes and the 16th annual meeting of the Fine Particle Society; Miami Beach, FL, USA (22 Apr 1985).

The behavior of aerosols assumed to be characteristic of those generated during light water reactor (LWR) accident sequences and released into containment is being studied in the Nuclear Safety Pilot Plant (NSPP) which is located at the Oak Ridge National Laboratory (ORNL). The program plan for the NSPP aerosol project provides for the study of the behavior, within containment, of simulated LWR accident aerosols emanating from fuel, reactor core structural materials, and from concrete-molten core materials interactions. The aerodynamic behavior of each of these aerosols was studied individually to establish its characteristics; current experiments involve mixtures of these aerosols to establish their interaction and collective behavior within containment. Tests have been conducted with U_3O_8 aerosols, Fe_2O_3 aerosols, and concrete aerosols in an environment of either dry air [relative humidity (RH) less than 20%] or steam-air [relative humidity (RH) approximately 100%] with aerosol mass concentration being the primary experimental variable.

30847 (CONF-850406—10) Downstream behavior of volatile fission product species. Farahat, M.; Settle, J.; Johnson, I.; Johnson, C.E. (Argonne National Lab., IL (USA)). 1985. Contract W-31-109-ENG-38. 11p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85012124.

From International symposium and workshop on particulate and multi-phase processes and the 16th annual meeting of the Fine Particle Society; Miami Beach, FL, USA (22 Apr 1985).

An experimental facility was constructed to study the behavior of volatile fission product (VFP) species in a flowing steam environment. Experiments were conducted using CsI as the VFP. An aqueous solution of CsI was injected into 1000°C superheated steam flowing into a horizontal pipe, 3.7 m long, under a controlled temperature gradient. The distribution of CsI deposits along the pipe wall was determined. Scanning electron microscopy was used for inspecting the deposits. Vapor condensation patterns and aerosol particles were identified. Comparison of the experimental results with predictions of the Reactor Aerosol Formation and Transport (RAFT) computer code was made.

30848 (CONF-850410—41) Acceptability of local boiling during shutdown heat removal. Dunn, F.E. (Argonne National Lab., IL (USA)). 1985. Contract W-31-109-ENG-38. 6p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85012115.

From ANS/ENS fast reactor safety meeting; Knoxville, TN, USA (21 Apr 1985).

Failures in the shutdown heat removal system of an LMFBR might lead to flow stagnation and coolant boiling in the reactor core. At normal operating power, the onset of sodium boiling will lead to film dryout and melting of the cladding and fuel within a few seconds. On the other hand, both calculations and currently available experimental data indicate that at neat fluxes corresponding to decay heat power levels, boiling leads to improved heat removal; and it limits the temperature rise in the fuel pins. Therefore, when setting criteria for decay heat removal systems, there is no reason to preclude sodium boiling per se because of heat removal considerations.

30849 (CONF-850410—43) Accommodation of unprotected accidents by inherent safety design features in metallic and oxide-fueled LMFBRs. Cahalan, J.E.; Sevy, R.H.; Su, S.F. (Argonne National Lab., IL (USA)). 1985. Contract W-31-109-ENG-38. 8p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85012114.

From ANS/ENS fast reactor safety meeting; Knoxville, TN, USA (21 Apr 1985).

This paper presents the results of a study of the effectivness of intrinsic design features to mitigate the consequences of unprotected accidents in metallic and oxide-fueled LMFBRs. The accidents analyzed belong to the class generally considered to lead to core disruption; unprotected loss-of-flow (LOF) and transient overpower (TOP). Results of the study demonstrate the potential for design features to meliorate accident consequences, and in some cases to render them benign. Emphasis is placed on the relative performance of metallic and oxide-fueled core designs.

30850 **(CONF-850410—47) Scoping studies of vapor behavior during a severe accident in a metal-fueled reactor.** Spencer, B.W.; Marchaterre, J.F. (Argonne National Lab., IL (USA)). 15 Apr 1985. Contract W-31-109-ENG-38. 17p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85011474.

From ANS/ENS fast reactor safety meeting; Knoxville, TN, USA (21 Apr 1985).

Scoping calculations have been performed examining the consequences of fuel melting and pin failures for a reactivity-insertion type accident in a sodium-cooled, pool-type reactor fueled with a metal alloy fuel. The principal gas and vapor species released are shown to be Xe, Cs,and bond sodium contained within the fuel porosity. Fuel vapor pressure is insignificant, and there is no energetic fuel-coolant interaction for the conditions considered. Condensation of sodium vapor as it expands into the upper sodium pool in a jet mixing regime may occur as rapidly as the vapor emerges from the disrupted core (although reactor-material experiments are needed to confirm these high condensation rates). If the predictions of rapid direct-contact condensation can be verified experimentally for the sodium system, the implication is that the ability of vapor expansion to perform appreciable work on the system is largely eliminated. Furthermore, the ability of an expanding vapor bubble to transport fuel and fission product species to the cover gas region where they may be released to the containment is also largely eliminated. The radionuclide species except for fission gas are largely retained within the core and sodium pool.

30851 **(CONF-850410—48) Role of fuel bubble phenomenology in assessment of LMFBR source term.** Cho, D.H.; Condiff, D.W.; Chan, S.H. (Argonne National Lab., IL (USA); Wisconsin Univ., Milwaukee (USA). Dept. of Mechanical Engineering). 1985. Contract W-31-109-ENG-38. 7p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85012110.

From ANS/ENS fast reactor safety meeting; Knoxville, TN, USA (21 Apr 1985).

Phenomenological aspects of a fuel vapor bubble formed in the sodium pool in a hypothetical severe accident are considered. The potential for fuel bubble collapse in the sodium pool is analyzed. It appears that for a wide range of hypothetical LMFBR accidents involving core vaporization, the fuel vapor bubble would likely be quenched and collapse prior to migration to the cover gas region. Such rapid quenching is due mainly to radiative heat transfer from the fuel bubble, coupled with the inherent capability of the sodium pool (large subcooling and high thermal conductivity) to dissipate thermal energy. Major uncertainty in the analysis concerns fuel vapor condensation phenomena at the sodium interface and its effect on the sodium surface radiation absorptivity. This is discussed in detail.

30852 **(CONF-850410—49) Quantitative analysis of the effect of complex internals on LMFBR containment during energetic accidents.** Zeuch, W.R.; Wang, C.Y. (Argonne National Lab., IL (USA)). 1985. Contract W-31-109-ENG-38. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85012111.

From ANS/ENS fast reactor safety meeting; Knoxville, TN, USA (21 Apr 1985).

This paper discusses the effects of complex internals on the containment response of large LMFBRs during energetic accidents. Results of a series of analyses with the ALICE-II code demonstrate quantitative structural and hydrodynamic effects from parametric variation of reactor internal designs. Effects of various upper internal structure treatments, structural stiffness of the upper internal structure and core support structure, and the location and dimensions of internal components are examined. Results indicate that reduction of primary containment loads can be accomplished through such means as confinement of the core region and avoiding overstrengthened, rigid internals. A study of the beneficial and adverse parameters involved in primary containment response should be helpful in optimizing designs for safety purposes.

30853 **(CONF-850417—23) Development of the flowsheet used for decontaminating high-activity-level water at TMI-2. Draft.** Collins, E.D.; Campbell, D.O.; King, L.J.; Knauer, J.B.; Wallace, R.M. (Oak Ridge National Lab., TN (USA); Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1985. Contract AC05-84OR21400. 31p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85012782.

From 189. national meeting of the American Chemical Society; Miami, FL, USA (28 Apr 1985).

Using a few small samples of high-activity-level water from TMI-2, a chemical processing flowsheet was developed for decontamination of the water and concentration of the radioactive contaminants in a form suitable for disposal. The initially selected process was evaluated and significantly improved. The improved process included sorption of the bulk radioactive materials, cesium and strontium, onto a mixture of inorganic zeolites and sorption of the anionic contaminants, antimony and ruthenium, plus the remaining traces of cesium and strontium onto standard organic ion exchange resins. The latter step was accomplished by means of a special deionization/sorption technique.

30854 **(CONF-850570—5) ORNL's NRC-sponsored HTGR safety and licensing analysis activities for Fort St. Vrain and advanced reactors.** Ball, S.J.; Cleveland, J.C.; Harrington, R.M. (Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 11p. NTIS, PC A02/MF A01 - GPO. File Number TI85012098.

From IAEA specialists' meeting on gas cooled reactors; Oak Ridge, TN, USA (13 May 1985).

The ORNL safety analysis program for the HTGR was established in 1974 to provide technical assistance to the USNRC on licensing questions for both Fort St. Vrain and advanced plant concepts. The emphasis has been on development of major component and system dynamic simulation codes, and use of these codes to analyze specific licensing-related scenarios. The program has also emphasized code verification, using Fort St. Vrain data where applicable, and comparing results with industry-generated codes. By the use of model and parameter adjustment routines, safety-significant uncertainties have been identified. A major part of the analysis work has been done for the Fort St. Vrain HTGR, and has included analyses of FSAR accident scenario re-evaluations, the core block oscillation problem, core support thermal stress questions, technical specification upgrade review, and TMI action plan applicability studies. The large, 2240-MW(t) cogeneration lead plant design was analyzed in a multi-laboratory cooperative effort to estimate fission product source terms from postulated severe accidents.

30855 **(CONF-850570—6) Simulation of thermal response of the 250 MWT modular HTGR during hypothetical uncontrolled heatup accidents.** Harrington, R.M.; Ball, S.J. (Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 12p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85012102.

From IAEA specialists' meeting on gas cooled reactors; Oak Ridge, TN, USA (13 May 1985).

One of the central design features of the 250 MWT modular HTGR is the ability to withstand uncontrolled heatup accidents without severe consequences. This paper describes calculational studies, conducted to test this design feature. A multi-node thermal-hydraulic model of the 250 MWT modular HTGR reactor core was developed and implemented in the IBM CSMP (Continuous System Modeling Program) simulation language. Survey calculations show that the loss of forced circulation accident with loss of steam generator cooling water and with accidental depressurization is the most severe heatup accident. The peak hot-spot fuel temperature is in the neighborhood of 1600°C. Fuel failure and fission product releases for such accidents would be minor. Sensitivity studies show that code input assumptions for thermal properties such as the side reflector conductivity have a significant effect on the peak temperature. A computer model of the reactor vessel cavity concrete wall and its surrounding earth was developed to simulate the extremely unlikely and very slowly-developing heatup accident that would take place if the worst-case loss of forced primary coolant circulation accident were further compounded by the loss of cooling water to the reactor vessel cavity liner cooling system. Results show that the ability of the earth surrounding the cavity to act as a satisfactory long-term heat sink is very sensitive to the assumed rate of decay heat generation and on the effective thermal conductivity of the earth.

30856 **(CONF-850610—6) Degraded core study using the multidimensional COMMIX code.** Chen, B.C.; Domanus, H.M.; Sha, W.T.; Sehgal, B.R. (Argonne National Lab., IL (USA)). 1985. Contract W-31-109-ENG-38. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85006196.

From Annual meeting of the American Nuclear Society; Boston, MA, USA (9 Jun 1985).

Considerable interest has been generated recently in the area of reactor coolant system (RCS) flow behavior during conditions of inadequate core cooling (ICC) and severe accidents. The natural convection phenomena in the multidimensional domain have a significant effect on the accident scenario and consequences. The heat transfer and fission product migration could be very different in a one-dimensional geometry when compared with that of a two- or three-dimensional geometry. Existing analytic tools in analyzing the three-dimensional natural convection phenomena are very scarce. The most well-known codes such as RELAP-5 and TRAC are inadequate in treating the recirculating flows such as countercurrent flows in the hot legs. Because of this consideration, the multidimensional COMMIX code was used for this degraded core study.

30857 **(CONF-850629—1-Summ.) Distribution of fission products in an LMFBR: summary.** Villarreal, R.; Young, J.O. (Argonne National Lab., Idaho Falls, ID (USA)). 1985. Contract W-31-109-ENG-38. 7p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85002770.

From International conference on analytical chemistry in nuclear technology; Karlsruhe, F.R. Germany (4 Jun 1985).

The overall distribution of fission products released from experimental subassemblies containing breached fuel elements has been determined in the fuel and throughout the EBR-II primary and secondary reactor systems. Identification of the fission products released to the primary sodium and location of areas of concentration was important in anticipating radioactive species and levels of deposited fission and activation products on components removed from the primary tank for maintenance and repair. The results of extensive radioanalytical measurements on the fuel, fuel cladding, primary sodium and cover gas system, secondary sodium and cover gas system and steam system are summarized.

30858 **(CONF-8504126—1) Ultra-reliable computer systems: an integrated approach for application in reactor safety systems.** Chisholm, G.H. (Argonne National Lab., Idaho Falls, ID (USA)). 1985. Contract W-31-109-ENG-38. 20p. (CONF-850610—28). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85010487.

From EPRI fault-tolerant systems seminar; Phoenix, AZ, USA (1 Apr 1985).

Improvements in operation and maintenance of nuclear reactors can be realized with the application of computers in the reactor control systems. In the context of this paper a reactor control system encompasses the control aspects of the Reactor Safety System (RSS). Equipment qualification for application in reactor safety systems requires a rigorous demonstration of reliability. For the purpose of this paper, the reliability demonstration will be divided into two categories. These categories are demonstrations of compliance with respect to (a) environmental; and (b) functional design constrains. This paper presents an approach for the determination of computer-based RSS respective to functional design constraints only. It is herein postulated that the design for compliance with environmental design constraints is a reasonably definitive problem and within the realm of available technology. The demonstration of compliance with design constraints respective to functionality, as described herein, is an extension of available technology and requires development.

30859 **(DEMO—83/17) Temperature estimations in air cooled fuel elements on an open pool research reactor core after loss of coolant.** Bartzis, J.G. (Democritos Nuclear Research Center, Athens (Greece)). Nov 1983. 48p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85701505.

In open pool research and test reactors it is essential to demonstrate, in the case of loss of the tank water under accident conditions, that the ambient air is capable of keeping the temperature level below the melting point. This work is part of an effort to build capability of predicting fuel temperature in the air-cooled core of the Greek Research Reactor-1 (GRR-1) or similar ones. To this purpose a 3-D computer program named ThEAP-I is under development. Temperature calculations are performed taking into consideration important factors such as external and internal natural convection, heat radiation, grid plate effect, interrupted daily and weekly reactor working schedule, number of fuel cycles for a particular fuel element, etc. In the present work the overall problem of modelling, as well as certain applications are presented and discussed.

30860 **(DOE/HTGR—85-026) Quantitative HTGR safety and forced outage goals.** Houghton, W.J.; Parme, L.L.; Silady, F.A. (GA Technologies, Inc., San Diego, CA (USA)). May 1985. Contract AT03-84SF11963. 12p. (CONF-850570—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE85011737.

From IAEA specialists' meeting on gas cooled reactors; Oak Ridge, TN, USA (13 May 1985).

A key step in the successful implementation of the integrated approach is the definition of the overall plant-level goals. To be effective, the goals should provide clear statements of what is to be achieved by the plant. This can be contrasted to the current practice of providing design-prescriptive criteria which implicitly address some higher-level objective but restrict the designer's flexibility. Furthermore, the goals should be quantifiable in such a way that satisfaction of the goal can be measured. In the discussion presented, two such plant-level goals adopted for the HTGR and addressing the impact of unscheduled occurrences are described. 1 fig.

30861 **(EGG-M—07585) Reactor containment purge and vent valve performance experiments.** Hunter, J.A.; Steele, R.; Watkins, J.C. (EG and G Idaho, Inc., Idaho Falls (USA)). 1985. Contract AC07-76ID01570. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85012611.

Three nuclear-designed butterfly valves typical of those used in domestic nuclear power plant containment purge and vent applications were tested. For a comparison of responses, two eight-inch nominal pipe size valves with differing internal design were tested. For extrapolation insights, a 24-inch nominal pipe size valve was also tested. The valve experiments were performed with various piping configurations and valve disc orientations to the flow, to simulate various installation options in field application. As a standard for comparing the effects of the installation options, testing was also performed in a standard ANSI test section. Test cycles were performed at inlet pressures of 5 to 60 psig, while monitoring numerous test parameters, such as the valve disc position, valve shaft torque, mass flow rate, and the pressure and temperature at multiple locations throughout the test section. An experimental data base was developed to assist in the evaluation of the current analytical methods and to determine the influence of inlet pressure, inlet duct geometry, and valve orientation to the flow media on valve torque requirements, along with any resulting limitations to the extrapolation methods. 2 refs., 15 figs.

30862 **(EGG-M—11485) Description of the Semiscale Mod-2C Facility, including scaling principle and current measurement capabilities.** Shaw, R.A.; Boucher, T.J.; Loomis, G.G. (Idaho National Engineering Lab., Idaho Falls (USA)). 1985. Contract AC07-76ID01570. 14p. (CONF-850646—3). NTIS, PC A02. File Number DE85012615.

From 2. international specialists meeting on small break LOCA analyses in LWRs; Pisa, Italy (24 Jun 1985).

This paper provides a general description of the Semiscale Mod-2C Facility. The scaling principle (modified volume) is discussed including the relative merits and disadvantages with respect to PWR characterization. A summary of the current thermal-hydraulic measurement capabilities is also included.

30863 **(EGG-TMI—6859) Computer code calculations of the TMI-2 accident: initial and boundary conditions.** Behling, S.R. (EG and G Idaho, Inc., Idaho Falls (USA)). May 1985. Contract AC07-76ID01570. 49p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85012613.

Initial and boundary conditions during the Three Mile Island Unit 2 (TMI-2) accident are described and detailed. A brief description of the TMI-2 plant configuration is given. Important contributions to the progression of the accident in the reactor coolant system are discussed. Sufficient information is provided to allow calculation of the TMI-2 accident with computer codes.

30864 **(EPRI-NP—3838) Review of selected topics from PRA studies: system dependencies, human interactions, and containment event trees.** Orvis, D.D.; Deremer, R.K.; Frank, M.V.; Joksimovich, V. (NUS Corp., San Diego, CA (USA)). May 1985. 265p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920659.

A Phase II review has been conducted by the NUS Corporation of probabilistic risk assessment (PRA) studies for five plants: Big Rock Point, Zion, Limerick, Grand Gulf and Arkansas Nuclear One - Unit 1. The results of the Phase I review reported in "A Review of Some Early Large-Scale Probabilistic Risk Assessments" addressed a wide range of topics and issues that make up a PRA study. Phase II provides a greater depth of review in three key areas of PRA analyses that appeared to affect the results of the studies most: system dependencies, human interactions, and containment event trees. The review includes selected sensitivity analyses of key parameters and assumption with the objective of determining whether differences between results of PRAs reviewed, with respect to dominant accident sequences for significant core damage and/or significant releases, are attributable to physical differences between plants (design, site or operation) or to analytical differences between studies (methodology and assumptions).

30865 (EPRI-NP—3912-SR-Vol.1, pp 2.1-2.11) **Multiple components malfunction scenarios--a classification technique with emphasis on shared-cause events.** Crellin, G.L.; Jacobs, I.M.; Kujawski, E.; Smith, A.M.; Worledge, D. (Los Alamos Technical Associates, Inc., San Jose, CA). Feb 1985. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $125.00. File Number TI85920509. (CONF-850206—Vol.1).

From International ANS/ENS topical meeting on probabilistic safety methods and applications; San Francisco, CA, USA (24 Feb 1985).

The authors of this study, under EPRI sponsorship, undertook the task of formulating a working definition for common-cause failure; however, they discovered such a wide diversity of event scenarios that no simple definition proved to be helpful. The alternative was to devise a classification system for all event scenarios, but designed with the ability to handle shared-cause phenomena. The objectives of pursuing this line of investigation are three-fold: 1) develop a logical and credible method for dissecting and understanding actual component malfunction scenarios in order to identify multiple events where the shared-cause phenomenon is important; 2) support various analyses, including probabilistic risk assessments, with a means of segregating data for use in statistical and modeling evaluations; and 3) assess the effectiveness of defensive strategies that may be employed where a need to reduce the impact of shared-cause malfunctions exists. Having established the clear distinction between root causes and component causes and between failures and functional unavailabilities, an event scenario can be readily broken down into its elementary parts wherein each component has an identifiable cause of its unavailability and each scenario has an overall classification. The heart of this system is a device called a Cause-Effect Logic Diagram which depicts the interrelationship between causes and components.

30866 (EPRI-NP—3912-SR-Vol.1, pp 3.1-3.14) **Common cause data analysis and implications in system modeling.** Fleming, K.N.; Mosleh, A. (Pickard, Lowe and Garrick, Inc., Newport Beach, CA). Feb 1985. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $125.00. File Number TI85920509. (CONF-850206—Vol.1).

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The purpose of this paper is to discuss some recent advances that have been made in the treatment of dependent events in the utility-sponsored probabilistic risk assessments (PRA) on Seabrook and Midland nuclear power plants and in research projects sponsored by the Electric Power Research Institute (EPRI). The particular topics of interest in this paper are the applications of a classification system to the development of a dependent events data base and the analysis of these data to support system level modeling and quantification of dependent events of the type performed in applied risk and reliability evaluation. The EPRI classification system has made it possible to develop a dependent events data base to support qualitative and quantitative systems analyses. The portion of the data base completed thus far for selected components has identified 422 dependent events, of which 113 have been classified as generic common cause events. Many of the existing published PRA studies, especially those that did not include parametric modeling of common cause events, did not account for most of these 113 events. This is due to overreliance on explicit modeling, which has proved reliable only for those dependent events resulting from the functional dependence among several components. It is important that future applied risk and reliability studies be held accountable for all experienced and documented dependent events.

30867 (EPRI-NP—3912-SR-Vol.1, pp 4.1-4.11) **Common cause failure methods dealing with dependent failures; a comparative application to US diesel generator data based on licensee event reports.** Virolainen, R.; Buslik, A. Feb 1985. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $125.00. File Number TI85920509. (CONF-850206—Vol.1).

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The best treatment of dependent failures is an undecided issue in reliability analysis at present. In practice, only Flemings β-factor method and recently Atwood's Binomial failure rate common cause model have obtained more general approval in the probabilistic risk analyst community. The authors compare the above mentioned parametric common cause failure models to each other, as well as to some non-parametric models using actual diesel generator data originating in Licensee Event Reports (LER). In this context they use the lognormal distribution to fit the failure rates from LER data and compare this with the distribution determined by the binomial failure rate model. They also compare the β-factors obtained directly from data to those from Atwood's method. Based on this data base, they calculate the plant-by-plant unavailability distributions for the 1 out of 2 diesel generator system using the β-factor method, Atwood's method, Hartung's correlation model (non-parametric), and the estimated lognormal distributions assuming 1) independence and 2) complete dependence (statistical correlation) between parallel diesel generators. Due to the excellent data base, they have also been able to estimate the unavailability distribution directly from data using the individual failure rates of parallel diesel generators. These unavailability distributions are then compared to those obtained by different methods; the parameters compared are the mean, median and measures of uncertainty.

30868 (EPRI-NP—3912-SR-Vol.1, pp 5.1-5.9) **Survey and evaluation of system interaction events and sources.** Murphy, G.A.; Johnson, M.P.; Rooney, J.J.; Casada, M.L.; Muhlheum, M.D.; Turner, J.H. (Oak Ridge National Lab., TN). Feb 1985. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $125.00. File Number TI85920509. (CONF-850206—Vol.1).

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In 1974, the Advisory Committee on Reactor Safeguards (ACRS) recommended to the Nuclear Regulatory Commission (NRC) that undesirable system interactions involving safety systems should be analyzed in the licensing of standardized designs for nuclear power plants. This ACRS interest, along with concern expressed by members of the NRC staff, led to the initiation, in 1978, of the Unresolved Safety Issue A-17, System Interaction. This paper describes a project that is part of the current activities scheduled to resolve this safety issue during calendar year 1985. This project was sponsored by the NRC Generic Issues Branch and conducted by the Nuclear Operations Analysis Center at the Oak Ridge National Laboratory. The project objectives were to identify system interaction events that have been reported by licensed nuclear power plants and to collect information about those events. These events include both events that have occurred and events that have been postulated. This operating experience review was seen as a first step in assessing the significance of potential system interaction events and in determining how to resolve the safety issue.

30869 (EPRI-NP—3912-SR-Vol.1, pp 6.1-6.10) **Analysis of dependent failures in the ORNL precursor study.** Ballard, G.M. Feb 1985. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $125.00. File Number TI85920509. (CONF-850206—Vol.1).

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The study of dependent failures (or common cause/mode failures) in the safety assessment of potentially hazardous plant is one of the significant areas of uncertainty in performing probabilistic safety studies. One major reason for this uncertainty is that data on dependent failures is apparently not readily available in sufficient quantity to assist in the development and validation of models. The incident reports that were compiled for the ORNL study on Precursors to Severe Core Damage Accidents (NUREG/CR-2497) provide an opportunity to look at the importance of dependent failures in the most significant incidents of recent reactor operations, to look at the success of probabilistic risk assessment (PRA) methods in accounting for the contribution of dependent failures, and to look at the dependent failure incidents with the aim of identifying the most significant problem areas. In this paper an analysis has been made of the incidents compiled in NUREG/CR-2497 and events involving multiple failures which were not independent have been identified. From this analysis it is clear that dependent failures are a very significant contributor to the precursor incidents. The method of enumeration of accident frequency used in NUREG-2497 can be shown to take account of dependent failures and this may be a significant factor contributing to the apparent difference between the precursor accident frequency and typical PRA frequencies.

30870 (EPRI-NP—3912-SR-Vol.1, pp 7.1-7.13) **Implementation of safety goals in NRC's regulatory process.** Murley, T.E. (Nuclear Regulatory Commission, Washington, DC). Feb 1985. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $125.00. File Number TI85920509. (CONF-850206—Vol.1).

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In May 1983 the Nuclear Regulatory Commission issued a policy statement on Safety Goals For Nuclear Power Plant Operation. The Commission at the same time judged that a two-year evaluation period was necessary to judge the effectiveness of the goals and design objectives, and directed the staff to develop information and understanding as to how to further define and use the design objectives and the cost-benefit guidelines. In carrying out the Commission's mandate, the staff framed three major questions to be addressed during the safety goal evaluation period. These three questions are: 1) to what extent is it practical to use safety goals in the regulatory process? 2) Should the quantitative design objectives be modified or supplemented? If so, how? 3) How should the safety goals be implemented at the end of the evaluation period? The staff's conclusions are discussed.

30871 (EPRI-NP—3912-SR-Vol.1, pp 8.1-8.11) **Safety performance targets; status in Europe.** Gilby, E.V.; Versteeg, J.; Van Reijen, G.; Vinck, W. (Gilby Associates, Knutsford, England). Feb 1985. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $125.00. File Number TI85920509. (CONF-850206—Vol.1).

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The Commission of the European Communities started about 12 years ago, together with Member States experts from licensing authorities, utilities and manufacturers an effort of harmonization of methodologies, criteria standards and codes for light water reactor safety (Working Group N 1 on LWR Safety). After consultation with this Working Group, the Commission of the EC in 1982 set up a special group with the task to report on the status of the need, possibilities and limitations for/of overall safety objectives for Nuclear Power Plants. As a result in May 1983 a "Status Report on Safety Goals/Objectives" has been published. At about the same time statements/comments have been formulated by the Task Force and submitted to USNRC on the "USNRC Policy Statement on Safety Goals for the Operation of Nuclear Power Plants" and the related "Evaluated Plan". The Task Force decided in June 1984 to undertake further activities, which have started already. The first results of these activities are mentioned in the paper.

30872 (EPRI-NP—3912-SR-Vol.1, pp 10.1-10.10) **Applicability of quantitative safety goals in the NRC's regulatory process.** Sauter, G.D.; Hughes, E.A. (Electric Power Research Inst., Palo Alto, CA). Feb 1985. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $125.00. File Number TI85920509. (CONF-850206—Vol.1).

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Nuclear Safety Analysis Center (NSAC) has conducted an initial study of the concept and applicability of alternative numerical safety goals, including the goals now under evaluation by the Nuclear Regulatory Commission (NRC) and other performance criteria formats. The basic approach was to address two fundamental questions: 1) Under what conditions, in what forms, and for what purposes are numerical goals or criteria most likely to be useful? 2) given that numerical goals appear to be useful, what is an appropriate method for setting them? The objective of this study was not to provide definitive answers to these questions, to recommend any specific numerical goals or criteria, or to propose any particular uses of such goals. Rather, it was to shed enough light on the concept and applicability of numerical goals, through developing some insights regarding the above questions and the issues they raise, to determine whether a more detailed, in-depth addressing of the questions is appropriate. This paper briefly summarizes why the EPRI/NSAC study was initiated, how it was carried out, and what its results were.

30873 (EPRI-NP—3912-SR-Vol.1, pp 12.1-12.7) **Tentative quantitative safety goal and examples of its possible application for the assessment of incident and accident sequences.** Gottschalk, P.A.; Hofer, E.; Jahns, A.; Werner, W. (Gesellschaft fuer Reaktorsicherheit mbH, Koeln, West Germany). Feb 1985. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $125.00. File Number TI85920509. (CONF-850206—Vol.1).

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The assessment of risk and the appropriate form of quantitative safety goal has many different aspects. In the paper, some aspects are pointed out. In particular, results of a study performed by GRS are presented. An example of a tentitative safety goal is shown with the intention to give guidance for further development and improvement of safety features also with regard to severe accidents.

30874 (EPRI-NP—3912-SR-Vol.1, pp 13.1-13.10) **Development of systems performance standards based on probabilistic risk assessments.** Whitley, R.H.; Okrent, D. (Univ. of California, Los Angeles). Feb 1985. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $125.00. File Number TI85920509. (CONF-850206—Vol.1).

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Probabilistic risk assessments (PRA) of nuclear reactors now represent a substantial data base which describes relative plant accident potentials, plant failure modes, and plant system failure probabilities. The PRA analyses can be used to make design related decisions. In the past, however, nuclear plant design relied primarily on traditional engineering approaches along with quality control and regulatory review. In this study, the authors try to see whether system and subsystem performance standards can be extracted from a set of existing PRAs using contribution to core melt as the primary attribute of interest. The approach taken uses system and plant failure data from six pressurized water reactor PRAs. Importance measures are developed and applied to gage the impact of various systems on plant core melt. These measures are also applied to modified plant configurations which meet a dominant sequence core melt contribution limit of 1.0×10^{-5} core melts per plant per reactor year. In addition, plant failure modes are put into functional groups, and sequences are placed into accident classes. Together, these approaches define the failure characteristics of the six plants and seek to discern failure patterns and the defacto existence of performance standards. A method of limiting the sensitivity of the plant (measured as an increase in core melt frequency) to hypothetical increases in event unavailabilities is proposed. Bounding estimates of the effect of the standard pairs on plant core melt frequency are derived.

30875 (EPRI-NP—3912-SR-Vol.1, pp 14.1-14.10) **Decision-theoretical methodology for reliability and risk allocation in nuclear power plants.** Cho, N.Z.; Papazoglou, I.A.; Bari, R.A.; El-Bassioni, A. (Brookhaven National Lab., Upton, NY). Feb 1985. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $125.00. File Number TI85920509. (CONF-850206—Vol.1).

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This paper describes a methodology for allocating reliability and risk to various reactor systems, subsystems, components, operations, and structures in a consistent manner, based on a set of global safety criteria which are not rigid. The problem is formulated as a multiattribute decision analysis paradigm; the multiobjective optimization, which is performed on a PRA model and reliability cost functions, serves as the guiding principle for reliability and risk allocation. The concept of noninferiority is used in the multiobjective optimization problem. Finding the noninferior solution set is the main theme of the current approach. The assessment of the decision maker's preferences could then be performed more easily on the noninferior solution set. Some results of the methodology applications to a nontrivial risk model are provided and several outstanding issues such as generic allocation and preference assessment are discussed.

30876 (EPRI-NP—3912-SR-Vol.1, pp 15.1-15.11) **Overview of methods for uncertainty analysis and sensitivity analysis in probabilistic risk assessment.** Iman, R.L.; Helton, J.C. (Sandia National Labs., Albuquerque, NM). Feb 1985. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $125.00. File Number TI85920509. (CONF-850206—Vol.1). Contract AC04-76DP00789.

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Probabilistic Risk Assessment (PRA) is playing an increasingly important role in the nuclear reactor regulatory process. The assessment of uncertainties associated with PRA results is widely recognized as an important part of the analysis process. One of the major criticisms of the Reactor Safety Study was that its representation of uncertainty was inadequate. The desire for the capability to treat uncertainties with the MELCOR risk code being developed at Sandia National Laboratories is indicative of the current interest in this topic. However, as yet, uncertainty analysis and sensitivity analysis in the context of PRA is a relatively immature field. In this paper, available methods for uncertainty analysis and sensitivity analysis in a PRA are reviewed. This review first treats methods for use with individual components of a PRA and then considers how these methods could be combined in the performance of a complete PRA. In the context of this paper, the goal of uncertainty analysis is to measure the imprecision in PRA outcomes of interest, and the goal of sensitivity analysis is to identify the major contributors to this imprecision. There are a number of areas that must be considered in uncertainty analysis and sensitivity analysis for a PRA: (1) information, (2) systems analysis, (3) thermal-hydraulic phenomena/fission product behavior, (4) health and economic consequences, and (5) display of results. Each of these areas and the synthesis of them into a complete PRA are discussed.

30877 (EPRI-NP—3912-SR-Vol.1, pp 16.1-16.2) **Parameter and model uncertainty in seismic hazard analysis.** Cornell, C.A.; O'Hara, T. (Stanford Univ., CA). Feb 1985. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $125.00. File Number TI85920509. (CONF-850206—Vol.1).

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The input required by modern Probabilistic Safety Assessment (PSA), along with frequent requests by decision makers and regulators for quantitative statements of uncertainty in low probability hazard estimates, has required development of methodology to analyze and display the results of multiple seismic hypotheses. Because the number of hazard curves generated may be in the thousands, a computer program was developed to automatically handle alternative models, mean activity rates, b-values, and upper bound magnitudes. Also, a grouping routine has been incorporated into the program to present the results either as a small number of representative curves for input to a PSA or in a more traditional form, e.g., 16-50-84 percentiles. The advantage of a multiple hypothesis method is that experts not users can be used to define consistent hypotheses, and based upon their experience and the degree of support in the data, determine a weight (probability) defining a degree of belief associated with each individual hypothesis. This result is a quantification of their uncertainty. But once the analysis has been completed, and all possible alternatives have been addressed, subsequent assessments of seismic hazard will simply be rearrangements of the weights applied to the alternatives. In this manner, the seismic hazard, based upon more reliable and future information, can easily be updated.

30878 (EPRI-NP—3912-SR-Vol.1, pp 18.1-18.10) **Incorporation of phenomenological uncertainties in safety analysis - application to LMFBR core disruptive accident energetics.** Najafi, B.; Theofanous, T.G.; Rumble, E.T.; Atefi, B. (Science Applications International Corp., Los Altos, CA). Feb 1985. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $125.00. File Number TI85920509. (CONF-850206—Vol.1).

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The main difficulty in estimating the frequency and consequences associated with severe accidents is that there is no directly applicable data base with which to estimate these quantities. To circumvent this lack of direct data, numerous experiments and code analyses which attempt to simulate the expected behavior of accident phenomena are conducted. This body of information, albeit it has non-prototypical characteristics, can be used to help form qualitative conclusions about specific aspects of the physical behavior of these accidents. Integration of this information in a systematic and traceable manner can also provide a comprehensive description of the state of understanding of the physical behavior of the accidents. Estimates of accident frequency and consequence distributions can then be established based on these comprehensive descriptions to aid in understanding both the magnitudes and root causes of uncertainties in the risk. This paper describes just such an approach which was used to estimate frequencies and consequences and their uncertainties for LMFBR core disruptive accident energetics.

30879 (EPRI-NP—3912-SR-Vol.1, pp 21.1-21.8) **Response surface methodology for sensitivity and uncertainty analysis: performance and perspectives.** Olivi, L.; Brunelli, F.; Cacciabue, P.C.; Parisi, P. (Commission of the European Communities, Ispra, Italy). Feb 1985. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $125.00. File Number TI85920509. (CONF-850206—Vol.1).

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Two main aspects have to be taken into account in studying a nuclear accident scenario when using nuclear safety codes as an information source. The first one concerns the behavior of the code response and the set of assumptions to be introduced for its modelling. The second one is connected with the uncertainty features of the code input, often modelled as a probability density function (pdf). The analyst can apply two well-defined approaches depending on whether he wants major emphasis put on either of the aspects. Response Surface Methodology uses polynomial and inverse polynomial models together with the theory of experimental design, expressly developed for the identification procedure. It constitutes a well-established body of techniques able to cover a wide spectrum of requirements, when the first aspect plays the crucial role in the definition of the objectives. Other techniques such as Latin hypercube sampling, stratified sampling or even random sampling can fit better, when the second aspect affects the reliability of the analysis. The ultimate goal for both approaches is the selection of the variable, i.e. the identification of the code input variables most effective on the output and the uncertainty propagation, i.e. the assessment of the pdf to be attributed to the code response. The main aim of this work is to present a sensitivity analysis method, already tested on a real case, sufficiently flexible to be applied in both approaches mentioned.

30880 (EPRI-NP—3912-SR-Vol.1, pp 22.1-22.9) **Uncertainty bands in CCDF risk curves; their importance in decision making processes.** Stern, E.; Tadmor, J. (Israel Atomic Energy Commission, Tel-Aviv). Feb 1985. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $125.00. File Number TI85920509. (CONF-850206—Vol.1).

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In the present study, examples of uncertainty bands of early fatalities CCDF risk curves are shown for nuclear power plants located in two densely populated sites, A and B, which differ from each other mainly by the population distribution patterns and the meteorological conditions. The REMAND computer code was used for assessing the consequences of various severe accidents in a nuclear power plant. The accidents analyzed were the WASH-1400 types PWR-1, PWR-2 up to PWR-5 and the annual probabilities of occurrence therein were also adopted, for each accident. The uncertainty bands were obtained by using two sets of parameters in the consequence modelling part of the PRA, namely a conservative and best estimate set. Based on sensitivity studies it is believed that the conservative and the best estimate curves represent the 90%-95% and the 50% curves, respectively. In other words, it is believed that there is only a few percent chance of getting a complementary cumulative distribution function curve higher than the conservative one, and that the best estimate curve lies within a range of no more than +/-10% from the real 50% curve.

30881 (EPRI-NP—3912-SR-Vol.1, pp 23.1-23.10) **Insights gained from in-depth reviews of several industry generated PRAs.** Pratt, W.T.; Khatib-Rahbar, M.; Bari, R.A.; Rosenthal, J. (Brookhaven National Lab., Upton, NY). Feb 1985. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $125.00. File Number TI85920509. (CONF-850206—Vol.1).

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During the last several years BNL staff have performed in-depth reviews of the containment failure modes and fission product release analyses of all of the industry PRAs submitted to the Office of Nuclear Reactor Regulation, NRC. This program started with a reevaluation of the risks reported in the Zion and Indian Point Probabilistic Safety Studies (PWRs with large dry containments) and was followed by reviews of the Limerick (BWR with Mark II containment) and Big Rock Point (early BWR design) PRAs. Reviews of the GESSAR-II (BWR with a Mark III containment) and Millstone-3 (PWR with a subatmospheric containment) PRAs are nearing completion. This paper therefore presents the insights gained from extensive reevaluations of the risk associated with a wide range of reactor and containment designs. In particular, the paper shows how changing methodology has influenced our understanding of containment performance under degraded core conditions and how this influences the frequency, timing and magnitude of fission product release to the environment, which in turn impacts potential off-site consequences.

30882 (EPRI-NP—3912-SR-Vol.1, pp 24.1-24.10) **Review of probabilistic containment analyses and some suggested improvements.** Frank, M.V.; Deremer, R.K.; Sherry, R. Feb 1985. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $125.00. File Number TI85920509. (CONF-850206—Vol.1).

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The Electric Power Research Institute has sponsored an in-depth survey of five significant probabilistic risk assessments (PRAs) to provide a summary and an interpretation to help technical specialists and management personnel understand the state-of-the-art in risk assessment, the validity of the methods used and the conclusions reached. This paper summarizes the insights gained from the Phase II comparison of containment analyses. It then describes techniques, independently developed and implemented at NUS Corporation, that address some of the shortcomings identified herein. Two specific areas of containment analyses are discussed. These are: 1) assessment of the probability and mode of containment failure as a result of internal loadings and 2) quantification of phenomenological events in the containment event trees.

30883 (EPRI-NP—3912-SR-Vol.1, pp 25.1-25.13) **Containment failure pressure analysis for the Seabrook Station Probabilistic Safety Assessment.** Torri, A.; Peek, R. (Pickard, Lowe and Garrick, Inc., Newport Beach, CA). Feb 1985. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $125.00. File Number TI85920509. (CONF-850206—Vol.1).

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A comprehensive containment failure pressure analysis was performed to quantify best estimate failure pressures for a range of gross structural failure modes and local controlled leakage failure modes. Uncertainties in the failure pressures were quantified as probability distributions. Dependencies between failure modes were explicitly treated and composite probability distributions were determined for the gross structural failure pressure and for the controlled leak failure pressure. A conditional probability for controlled leak failure, given that failure occurs, was also developed as a function of pressure. The Seabrook Station containment is unusually strong. The composite median failure pressure is 172 psig for dry conditions and 195 psig for wet conditions, compared to a design pressure of 52 psig. At these pressures, the conditional probability for a controlled leak failure ranges from 0.76 to 0.88. At pressures likely to be reached early under accident conditions (125 psig or less) the containment failure probability is on the order of 10^{-4} or less and the controlled leak failure fraction is 0.04 or less. The conclusions are design-specific.

30884 (EPRI-NP—3912-SR-Vol.1, pp 26.1-26.11) **Consistent probabilistic methodology for the Seabrook Station containment event tree analysis.** Torri, A. (Pickard, Lowe and Garrick, Inc., Newport Beach, CA). Feb 1985. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $125.00. File Number TI85920509. (CONF-850206—Vol.1).

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A containment response analysis includes a quantification of accident progression, containment failure, and source terms. A consistent and fully probabilistic methodology was developed and applied in the Seabrook probabilistic risk assessment (PRA). A wide range of deterministic accident analyses were used as input to the probabilistic quantification of the containment event tree. The methodology embraces the definition of initial conditions, criteria for selecting top events, a probabilistic quantification of top event split fractions and the interpretation and propagation of uncertainties. The correct probabilistic interpretation of top event split fractions as uncertainties of deterministic events instead of frequencies of random events has important implications in the final risk results, when risk is stated in a probability of frequency format; that is, when the uncertainties in the frequency of consequences are explicitly quantified.

30885 (EPRI-NP—3912-SR-Vol.1, pp 28.1-28.4) **Containment event tree analysis for source term frequency estimation.** Behr, V.L.; Haskin, F.E. (Sandia National Labs., Albuquerque, NM). Feb 1985. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $125.00. File Number TI85920509. (CONF-850206—Vol.1). Contract AC04-76DP00789.

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One of the objectives of the Severe Accident Risk Reduction Program (SARRP) is to benchmark the risks from nuclear power plants. In order to accomplish this not only are estimates of the potential consequences from hypothetical reactor accidents needed; but estimates of the frequency of occurrence of such consequences must also be made since it is the combination of frequency and consequences which determine risk. The approach taken in SARRP to address this problem is to develop containment event trees which proceed from an accident sequence to different possibilities of fission product releases. This paper deals with the development of the containment event trees and treats the selection procedure used for estimating the branch point probabilities are shown for two sequences at a subatmospheric PWR.

30886 (EPRI-NP—3912-SR-Vol.1, pp 29.1-29.13) **Evaluation of containment failure modes and fission product releases during core meltdown accidents in a BWR with a Mark III containment.** Ludewig, H.; Yu, W.S.; Jaung, R.; Pratt, W.T. (Brookhaven National Lab., Upton, NY). Feb 1985. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $125.00. File Number TI85920509. (CONF-850206—Vol.1).

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In this paper an assessment is described of potential failure modes and fission product releases for a large number of postulated core meltdown accidents in a BWR with a Mark III containment. For this containment design, the most important failure mode was found to be due to hydrogen related phenomena. A one-dimensional lumped parameter computer code has been developed and used to determine the probability of various hydrogen phenomena for a range of postulated core meltdown sequences. Potential containment loads have been estimated and compared against the containment capacity to determine the probability of containment failure. The fission product release assessment began by using the MARCH/CORRAL system of codes with key input parameters varied over a reasonable range. The parameters relate to primary system retention, re-emission, pool scrubbing, and fission product release in-vessel vs. ex-vessel. The final step used more mechanistic calculations based on the system of codes recently developed under sponsorship of the Accident Source Term Program Office, NRC, and compares these predictions with the range of releases calculated in the sensitivity study.

30887 (EPRI-NP—3912-SR-Vol.1, pp 30.1-30.10) **PWR S_2D sequence analysis with THALES code system.** Abe, K.; Nishi, M.; Watanabe, N.; Kobayashi, K.; Kudo, K. (Japan Atomic Energy Research Institute, Tokyo). Feb 1985. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $125.00. File Number TI85920509. (CONF-850206—Vol.1).

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The Japan Atomic Energy Research Institute (JAERI) has been developing the computer code system THALES which analyzes the progress of the core meltdown accident for the purpose of risk analysis. With the code system, a series of studies were conducted for the PWR S_2D sequence (small break LOCA without ECCS), which consisted of: 1) a thorough analysis of an assumed sequence from beginning to end; 2) a sensitivity study for the in-vessel accident progress; and 3) a sensitivity study for the ex-vessel accident progress. The objectives of the studies were firstly to evaluate the performance of the code system and secondly to identify the important parameters in this sequence. In this report, after a brief description of THALES, the principal assumptions and the results of each study are described.

30888 (EPRI-NP—3912-SR-Vol.1, pp 31.1-31.4) **Opening remarks: regulatory initiatives toward improved technical specifications.** Edison, G.E. (Nuclear Regulatory Commission, Washington, DC). Feb 1985. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $125.00. File Number TI85920509. (CONF-850206—Vol.1).

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In order to deal with the numerous problems that have evolved over the years with nuclear power plant technical specifications, the Nuclear Regulatory Commission has undertaken some initiatives for improvement: 1) new operating licenses, 2) change to existing operating reactor technical specifications, 3) a broad-scoped reconsideration of the content of technical specifications, and 4) rule changes. It is believed that reliability and risk assessment techniques can be used in conjunction with manufacturer's recommendations and engineering judgment to better define the appropriate scope and depth for technical specification resulting in focusing attention on high risk-worth systems and avoidance of plant shutdown transients both intentionally and unintentionally through provisions of technical specifications.

30889 (EPRI-NP—3912-SR-Vol.1, pp 32.1-32.8) **Methodology for risk-based analysis of technical specifications.** Vesely, W.E.; Gaertner, J.P.; Wagner, D.P. (Battelle Columbus Labs., OH). Feb 1985. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $125.00. File Number TI85920509. (CONF-850206—Vol.1).

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Part of the effort by EPRI to apply probabilistic risk assessment methods and results to the solution of utility problems involves the investigation of methods for risk-based analysis of technical specifications. The culmination of this investigation is the SOCRATES computer code developed by Battelle's Columbus Laboratories to assist in the evaluation of technical specifications of nuclear power plants. The program is designed to use information found in PRAs to re-evaluate risk for changes in component allowed outage times (AOTs) and surveillance test intervals (STIs). The SOCRATES program is a unique and important tool for technical specification evaluations. The detailed component unavailability model allows a detailed analysis of AOT and STI contributions to risk. Explicit equations allow fast and inexpensive calculations. Because the code is designed to accept ranges of parameters and to save results of calculations that do not change during the analysis, sensitivity studies are efficiently performed and results are clearly displayed.

30890 (EPRI-NP—3912-SR-Vol.1, pp 33.1-33.12) **Experiences from the use of PRA methods in the re-evaluation of technical specifications.** Mankamo, T.; Perhonen, H.; Pulkkinen, U.; Kosonen, M.; Vanhala, J. (Technical Research Centre of Finland, Espoo). Feb 1985. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $125.00. File Number TI85920509. (CONF-850206—Vol.1).

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Extensive research and development work has been connected on a series of studies dealing with the optimization of test schemes and limiting conditions of operation (LCO) for stand-by safety systems. The studies were originally started on a common initiative from the Finnish Centre for Radiation and Nuclear Safety (the national authority) and the Technical Research Centre of Finland. This paper updates an earlier paper, which was limited to the question of the allowable repair down-time during operation. The emphasis here is on the recent method developments, and experiences from the current practical applications are discussed. In addition to method development much work has been required to collect relevant data for model parameters. Analyzing component and system histories have also provided valuable information for verification or modification of the models and assumptions. Thus far data analyses have been done for diesel generators, closing valves and pumps.

30891 (EPRI-NP—3912-SR-Vol.1, pp 34.1-34.15) **TOP: Technical Specification Optimization Program.** Lijewski, L.M.; Jansen, R.L. (Westinghouse Electric Corp.). Feb 1985. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $125.00. File Number TI85920509. (CONF-850206—Vol.1).

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The Westinghouse Technical Specification Optimization Program has been specifically developed to quantitatively assess proposed revisions to current nuclear power plant technical specifications. This program is a direct response to both industry and regulatory concerns as to the impact of technical specification requirements on plant operation, particularly instrumentation systems. A fault tree methodology which quantifies system unreliability and sensitivity to test and maintenance practices has been applied to typical Westinghouse reactor protection system designs. Reactor trip features and engineered safety features have both been analyzed. Technical specification revisions evaluated include: extended surveillance intervals, extended test and maintenance times, and testing in the bypass mode. This methodology and the analysis results present a justifiable quantitative basis for technical specification revisions.

30892 (EPRI-NP—3912-SR-Vol.1, pp 37.1-37.7) **Evaluation of allowed outage time using PRA results.** Johanson, G. (System Engineering, Sweden). Feb 1985. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $125.00. File Number TI85920509. (CONF-850206—Vol.1).

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In a probabilistic risk assessment (PRA) different measures of risk importance can be established. These measures can be used as a basis for further evaluation and determination of allowed outage time for specific components, within safety systems of a nuclear power plant. In order to optimize the allowed outage time (AOT) stipulated in the plant's Technical Specification it is necessary to create a methodology which could incorporate existing PRA data into a quantitative extrapolation. In order to evaluate the plant risk status due to AOT in a quantitative manner, the risk achievement worth is utilized. Risk achievement worth is defined as follows: to measure the worth of a feature, in achieving the present risk, one approach is to remove the feature and then determine how much the risk has increased. Thus, the risk achievement worth is formally defined to be the increase in risk if the feature were assumed not be there or to be failed. Another parameter of interest for this analysis is the shutdown risk increase. The shutdown risk achievement worth must be incorporated into the accident sequence risk achievement worth to arrive at an optimal set of plant specific AOTs.

30893 (EPRI-NP—3912-SR-Vol.1, pp 38.1-38.9) **Application of probabilistic safety analysis to plant operation: a demonstration.** Young, J.; Chu, B.B. Feb 1985. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $125.00. File Number TI85920509. (CONF-850206—Vol.1).

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Recently, several nuclear power plants have been upgrading their onsite data processing capabilities to take advantage of state-of-the-art advancements in data acquisition, data base management and computer hardware. These capabilities can now provide plant personnel with ready access to detailed information on every phase of equipment and administrative activity in the plant. However, the engineering and operational applications are just starting to be realized. At the Electric Power Research Institute (EPRI), a broad scope, ongoing research project entitled "Use of PRA Methods for Enhancing Plant Operational Safety and Reliability" is intended to develop a systematic and integrated approach to maximize the utilization of the plant data base system. Specifically, the project consists of two major activities: (1) to develop a user friendly, integrated computer software package, RAPID (Reliability Analysis Program with In-Plant Data), to perform these engineering and operational tasks and (2) to demonstrate the technical feasibility and practical usefulness of RAPID onsite. One of the initial efforts of this program is directed toward the development of a plant configuration and status monitoring system. As a part of the effort, EPRI is sponsoring a limited demonstration study of the concept. This paper describes the technical issues and approaches used in this phase of the demonstration study.

30894 (EPRI-NP—3912-SR-Vol.1, pp 39.1-39.10) **Essential systems status monitor.** Horne, B.E.; Pullen, R.A. (Central Electricity Generating Board, Gloucester, England). Feb 1985. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $125.00. File Number TI85920509. (CONF-850206—Vol.1).

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The operation of a nuclear power station requires that safety objectives are adequately satisfied in order to assure the safety of the operators and the general public. For the safety objectives to be satisfied, the essential systems of a nuclear power station are installed and operated with considerable redundancy in plant and equipment. It is a necessary requirement that in the presence of faults or outages of plant due to maintenance this redundancy is always maintained to an acceptable level. The Essential Systems Status Monitor (ESSM) is a computerized facility which is capable of quickly assessing the implications of plant outages on the integrity of the essential systems. The speed of response of the ESSM allows it to be used in an operating environment where it can also provide assistance in scheduling plant items for maintenance and assigning priorities for plant restoration. The ESSM is not restricted by the size, complexity and interrelation of the essential systems. The ESSM provides the operator with an air for assessing the integrity of available essential systems against the minimum requirements in a less pessimistic manner, thereby increasing the availability of the power station overall.

30895 (EPRI-NP—3912-SR-Vol.1, pp 41.1-41.14) **European Reliability Data System: main developments and use.** Amesz, J.; Capobianchi, S.; Kalfsbeek, H.W.; Mancini, G. (Commission of the European Communities, Ispra, Italy). Feb 1985. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $125.00. File Number TI85920509. (CONF-850206—Vol.1).

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The paper revises the aims and objectives of the European Reliability Data System (ERDS), a centralized system collecting and organizing information related to the operation of light water reactors. The paper first describes the recent developments of the four data banks constituting the system: Component Event Data Bank, Abnormal Occurrences Reporting System, Operating Unit Status Report and Reliability Parameters Data Bank. Then several issues are discussed referring mostly to the status of classification schemes and their use, to the operation of the banks (data input and transcoding) and to the retrieval and utilization of the information; in this latter case particularly the analysis potential of the data collection scheme of the AORS (Abnormal Occurrences Reporting System) is demonstrated. Finally, emphasis is given to the increasing role which artificial intelligence techniques such as natural language and expert systems and fuzzy logic may play in improving the future capabilities of the system.

30896 (EPRI-NP—3912-SR-Vol.1, pp 42.1-42.10) **Operating experience analysis contribution to probabilistic risk assessment: development and use of EDF data collection systems.** Meslin, T.; Lienart, P. (Electricite de France). Feb 1985. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $125.00. File Number TI85920509. (CONF-850206—Vol.1).

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EDF is developing probabilistic studies concerning beyond-design accidents of a 1300 Mw pressurized water reactor. Specifically the following three studies have been made: 1) components reliability for evaluating the unavailability and failure rates of the auxiliary feedwater system; 2) initiating event analysis of the loss of the normal feedwater system; and 3) setting up of a typical operating profile of a PWR standard unit. Implementation of the operating experience analysis has led to the precise identification and estimate of all initiating events which would induce total loss of normal feedwater and thus supports the probabilistic study of beyond-design accidents.

30897 (EPRI-NP—3912-SR-Vol.1, pp 43.1-43.10) **ATV-system and its use.** Ekberg, K.; Andersson, M.; Bento, J.P. (Swedish State Power Board, Vaellingby). Feb 1985. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $125.00. File Number TI85920509. (CONF-850206—Vol.1).

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The ATV-system, the Scandinavian Nuclear Power Reliability Data System, was developed during the late seventies and in the summer of 1980 the first reliability parameters were presented from the complete system. The main goal of the ATV-system is to produce reliability data and the appendant failure statistics for components of technical systems of importance for either the power production or the safety of the units. In order to achieve this, modern information system theory and advanced data processing techniques are used. Another important feature is the close cooperation with the local maintenance management system. Activities of importance for efficiency of power production which the system is to support with relevant data are reliability analyses, availability analyses, life cycle cost analyses, probabilistic risk assessments, planning and performance of maintenance, spare parts optimization, and trend analyses.

30898 (EPRI-NP—3912-SR-Vol.1, pp 44.1-44.7) **Applications of NPRDS data to enhance nuclear plant design and operations.** Simard, R.L. (Institute of Nuclear Power Operations, Atlanta, GA). Feb 1985. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $125.00. File Number TI85920509. (CONF-850206—Vol.1).

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The Nuclear Plant Reliability Data System (NPRDS) is managed by the Institute of Nuclear Power Operations (INPO) on behalf of the US nuclear utility industry. All US nuclear plants in commercial operation, absent three early-vintage units, supply detailed design data and failure reports on some 4000-5000 plant components from 30 systems important to safety or plant availability. Recent enhancements to NPRDS have significantly improved the completeness, timeliness, and quality of reporting. This has lead to increased usage of the data, especially by utility departments involved with plant design, maintenance, and operational support.

30899 (EPRI-NP—3912-SR-Vol.1, pp 45.1-45.9) **Analysis and use of operating experience in probabilistic risk assessment.** Apostolakis, G. (Univ. of California, Los Angeles). Feb 1985. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $125.00. File Number TI85920509. (CONF-850206—Vol.1).

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The purpose of this paper is to discuss several issues that arise when operating experience is used to develop or modify failure rate distributions. The main reasons for the existence of these issues are: 1) The events of interest are usually rare, therefore the statistical evidence is weak, or even nonexistent. This necessitates the use of evidence or judgments that may be debatable and controversial. 2) The data sources have not been designed to support probabilistic risk assessments (PRA). The definition and cause of failure as well as the numbers of failures and trials, if reported at all, depend very much on the purposes of the reporting system, which may or may not coincide with those of a probabilistic assessment. In this paper, the author first discusses several issues that arise when the operating experience is interpreted. The use of models to guide the analysts in the search for evidence is pointed out and some issues that may affect the relevance of the evidence are raised. The second part of the paper deals with the mathematical analysis of the evidence. The controversial issue of objectivity is discussed, as well as some issues related to the use of judgment. Finally, practical cases, where the issues that are raised are important, are presented.

30900 (EPRI-NP—3912-SR-Vol.1, pp 47.1-47.8) **Distributions of component failure rates, estimated from LER data.** Atwood, C.L. (EG and G Idaho, Inc., Idaho Falls). Feb 1985. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $125.00. File Number TI85920509. (CONF-850206—Vol.1).

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Past analyses of Licensee Event Report (LER) data have noted that component failure rates vary from plant to plant, and have estimated the distributions by two-parameter γ distributions. In this study, a more complicated distributional form is considered, a mixture of γs. This could arise if the plants' failure rates cluster into distinct groups. The method was applied to selected published LER data for diesel generators, pumps, valves, and instrumentation and control assemblies. The improved fits from using a mixture rather than a single γ distribution were minimal, and not statistically significant. There seem to be two possibilities: either explanatory variables affect the failure rates only in a gradual way, not a qualitative way; or, for estimating individual component failure rates, the published LER data have been analyzed to the limit of resolution.

30901 (EPRI-NP—3912-SR-Vol.1, pp 48.1-48.10) **Development of a generic data base for failure rate.** Mosleh, A.; Apostolakis, G. (Pickard, Lowe and Garrick, Inc., Newport Beach, CA). Feb 1985. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $125.00. File Number TI85920509. (CONF-850206—Vol.1).

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The data analysis task in a probabilistic risk assessment (PRA) involves the assessment of data needs, the collection of information, and, finally, the analysis of the data to generate estimates for various parameters. This paper describes a framework for developing a data base for component failure rates and presents mathematical methods for the analysis of various types of information. The discussion is focused on the development of generic data bases used in PRAs. For plants without an operating history, the generic distributions are used directly to calculate component unavailability. In the case of plants that have operated for some time, the generic distributions can be used as priors in Bayesian analysis and, thus, specialized by plant-specific experience.

30902 (EPRI-NP—3912-SR-Vol.1, pp 49.1-49.13) **Tectonic framework methodology for developing seismic source zones in the eastern United States.** Stepp, J.C.; Coppersmith, K.; King, J.L. (Electric Power Research Institute, Palo Alto, CA). Feb 1985. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $125.00. File Number TI85920509. (CONF-850206—Vol.1).

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The focus of a current EPRI research program is the development of a state-of-the-art method of seismic hazard analysis applicable in intraplate regions. The program emphasis is on the interpretation and resulting ground motions from seismic source zones that are capable of producing moderate-to-large (magnitude 5.0 or greater) earthquakes. The basis for seismic source zone development is a tectonic framework that includes tectonic structures or features interpreted to have any potential for generating moderate or large earthquakes. The approach developed for tectonic framework interpretation is a unique relative to standard hazard analyses because it is based on assessments of the current tectonic stress regime and the potential response of tectonic structures to the applied stresses. A structured approach for evaluating the probability that tectonic features of the tectonic framework capable of producing moderate-to-large earthquakes has been developed that explicitly quantifies both scientific uncertainty about earthquake processes and informational uncertainty due to inadequate data. This structured approach provides fully trackable documentation of the reasoning behind seismic source zones of any complexity derived from the tectonic framework.

30903 (EPRI-NP—3912-SR-Vol.1, pp 51.1-51.9) **Role of seismic PRA in seismic safety decisions of nuclear power plants.** Ravindra, M.K.; Kennedy, R.P.; Sues, R.H. (NTS/Structural Mechanics Associates, Newport Beach, CA). Feb 1985. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $125.00. File Number TI85920509. (CONF-850206—Vol.1).

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This paper highlights the important roles that seismic probabilistic risk assessments (PRAs) can play in the seismic safety decisions of nuclear power plants. If a seismic PRA has been performed for a plant, its results can be utilized to evaluate the seismic capability beyond the safe shutdown event (SSE). Seismic fragilities of key structures and equipment, fragilities of dominant plant damage states and the frequencies of occurrence of these plant damage states are reviewed to establish the seismic safety of the plant beyond the SSE level. Guidelines for seismic margin reviews and upgrading may be developed by first identifying the generic classes of structures and equipment that have been shown to be dominant risk contributors in the completed seismic PRAs, studying the underlying causes for their contribution and examining why certain other items (e.g., piping) have not proved to be high-risk-contributors.

30904 (EPRI-NP—3912-SR-Vol.1, pp 52.1-52.6) **Uncertainties in the systems analysis part of seismic probabilistic risk assessment.** Budnitz, R.J.; Lambert, H.E. Feb 1985. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $125.00. File Number TI85920509. (CONF-850206—Vol.1).

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This project has had as its principal objective the identification of methodological improvements in the systems analysis part of seismic probabilistic risk assessments (PRAs) performed on large nuclear power plants. Methods used in the following PRAs have been examined, with emphasis on areas where the systems analysis may have introduced approximations or may have inadequately modeled plant behavior: the Indian Point-2 and -3 PRA; the Zion-1 and -2 PRA; the Limerick PRA; and the SSMRP study of Zion. The following areas are discussed briefly: 1) level of detail in systems modeling; 2) modeling of operator response; 3) control and instrumentation failures and support system failures; and 4) modeling of equipment inside or dependent upon a structure.

30905 (EPRI-NP—3912-SR-Vol.1, pp 53.1-53.10) **Method for evaluation of risk due to seismic related design and construction errors based on past reactor experience.** Gonzalez Cuesta, M.; Okrent, D. (Univ. of California, Los Angeles). Feb 1985. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $125.00. File Number TI85920509. (CONF-850206—Vol.1).

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This paper proposes a methodology for quantification of risk due to seismic related design and construction errors in nuclear power plants, based on information available on errors discovered in the past. For the purposes of this paper, an error is defined as any event that causes the seismic safety margins of a nuclear power plant to be smaller than implied by current regulatory requirements and industry common practice. Also, the actual reduction in the safety margins caused by the error will be called a deficiency. The method is based on a theoretical model of errors, called a deficiency logic diagram. First, an ultimate cause is present. This ultimate cause is consumated as a specific instance, called originating error. As originating errors may occur in actions to be applied a number of times, a deficiency generation system may be involved. Quality assurance activities will hopefully identify most of these deficiencies, requesting their disposition. However, the quality assurance program is not perfect and some operating plant deficiencies may persist, causing different levels of impact to the plant logic. The paper provides a way of extrapolating information about errors discovered in plants under construction in order to assess the risk due to errors that have not been discovered.

30906 (EPRI-NP—3912-SR-Vol.1, pp 55.1-55.8) **Internal flooding: methods and results from the Oconee PRA.** Sugnet, W.R.; Lewis, S.R.; Boyd, G.J. (Electric Power Research Institute, Palo Alto, CA). Feb 1985. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $125.00. File Number TI85920509. (CONF-850206—Vol.1).

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The importance of internal flooding events for Oconee was determined by successively more detailed flood analyses. The methods used provide a model of the flood sequences that is as realistic and reproducible as that for the internal initiators. The authors conclude that with sufficient care and detail, analysis of most external events (the exception being seismic events within today's state-of-the-art) can be made to be the same caliber as that for internal events. The use of more detailed methods also provided a complete enough picture of the integrated effects of flooding on the plant to allow a meaningful evaluation of modifications to improve that plant's ability to withstand major floods. With the perspective provided by the PRA evaluations, it was possible to identify an effective set of modifications, many of which were inexpensive relative to the significant improvement they offered in the estimated frequency of core damage.

30907 (EPRI-NP—3912-SR-Vol.1, pp 56.1-56.8) **Modeling the detection and suppression of fires in nuclear power plants.** Siu, N.; Apostolakis, G. (Univ. of California, Los Angeles). Feb 1985. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $125.00. File Number TI85920509. (CONF-850206—Vol.1).

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The potential occurrence of fire damage to components can be modeled as the outcome of a competition between fire growth and fire suppression processes over time. To outline the time-dependent competing processes approach, assume that a fire has started at time t = 0, and that the fire size and room configuration are such that, if the fire is not suppressed, it will grow large enough to cause the loss of critical cables in Tray X at time t = T/sub G/. Then, if the fire actually burns until time t = T/sub H/, when it is suppressed, the conditional frequency of damage, given that the fire occurs, can be defined. In this paper, the authors outline a model for the fire hazard time T/sub H/, which accounts for the presence of site-specific fire protection features. It incorporates both data on the overall success rate of the various possible detection and suppression modes and on the characteristic rates associated with these modes. Uncertainties in the parameters of the model are fully quantified. To illustrate the use of this model in a fire risk study, a hypothetical scenario is analyzed.

30908 (EPRI-NP—3912-SR-Vol.1, pp 58.1-58.8) **Accident simulator development for probabilistic safety analysis.** Cacciabue, P.C.; Amendola, A.; Mancini, G. (Commission of the European Communities, Ispra, Italy). Feb 1985. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $125.00. File Number TI85920509. (CONF-850206—Vol.1).

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This paper describes the basic features of a new concept of incident simulator, Response System Analyzed (RSA) which is being developed within the CEC JRC Research Program on Reactor Safety. Focusing on somewhat different aims than actual simulators, RSA development extends the field of application of simulators to the area of risk and reliability analysis and in particular to the identification of relevant sequences, to the modeling of human behavior and to the validation of operating procedures. The fundamental components of the project, i.e. the deterministic transient model of the plant, the automatic probabilistic driver and the human possible intervention modeling, are discussed in connection with the problem of their dynamic interaction. The analyses so far performed by separately testing RSA on significant study cases have shown encouraging results and have proven the feasibility of the overall program.

30909 (EPRI-NP—3912-SR-Vol.1, pp 62.1-62.10) **Core damage frequency results for the Clinch River Breeder Reactor.** Akhtar, M.W.; Stutzke, M.A. (Technology for Energy Corp., Knoxville, TN). Feb 1985. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $125.00. File Number TI85920509. (CONF-850206—Vol.1). Contract AC15-83CL01819.

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A probabilistic risk assessment (PRA) for the Clinch River Breeder Reactor Plant (CRBRP) was recently completed by Technology for Energy Corporation, Knoxville, Tennessee, for the Department of Energy, Oak Ridge Operations Office. The PRA was performed in two phases with the second phase starting in January 1983. Phase II activities were originally planned to result in a Level 3 PRA with full-scope analysis of the external and common-cause events, as well as ex-core sources. The Phase II activities were cut short because of the termination of the CRBRP Project in November of 1983, at which point the scope of the PRA was changed to the following goals: 1) complete the CRBRP system models; 2) calculate the plant core-damage frequency; 3) study the core and containment phenomena in a probabilistic sense; 4) determine the design features important to plant safety, and therefore important to any considerations of new designs for liquid-metal reactors; and 5) extensively document the PRA to enable its use for other programs. This paper summarizes the frequency of core-damage accidents as assessed by this study. The discussion also includes the important design operational elements of the CRBRP that affect these results. A short overview of the methodology used is also provided.

30910 (EPRI-NP—3912-SR-Vol.1, pp 63.1-63.10) **Use of PRA methodology for enhancing operational safety and reliability.** Chu, B.; Rumble, E.; Najafi, B.; Putney, B.; Young, J. (Electric Power Research Institute, Palo Alto, CA). Feb 1985. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $125.00. File Number TI85920509. (CONF-850206—Vol.1).

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This paper describes a broad scope, on-going R and D study, sponsored by the Electric Power Research Institute (EPRI) to utilize key features of the state-of-the-art plant information management and system analysis techniques to develop and demonstrate a practical engineering tool for assisting plant engineering and operational staff to perform their activities more effectively. The study is foreseen to consist of two major activities: to develop a user-friendly, integrated software system; and to demonstrate the applications of this software on-site. This integrated software, Reliability Analysis Program with In-Plant Data (RAPID), will consist of three types of interrelated elements: an Executive Controller which will provide engineering and operations staff users with interface and control of the other two software elements, a Data Base Manager which can acquire, store, select, and transfer data, and Applications Modules which will perform the specific reliability-oriented functions. A broad range of these functions has been envisaged. The immediate emphasis will be focused on four application modules: a Plant Status Module, a Technical Specification Optimization Module, a Reliability Assessment Module, and a Utility Module for acquiring plant data.

30911 (EPRI-NP—3912-SR-Vol.1, pp 66.1-66.9) **Nuclear power plant design: contribution of probabilistic methods and their application to a total loss of electric power supplies.** Schektman, N.; Villemeur, A.; Berger, J.P.; Boisseau, J.; Dubreuil-Chambardel, A.; Mosneron-Dupin, F.; Septen, E.D.F. (Electricite de France). Feb 1985. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $125.00. File Number TI85920509. (CONF-850206—Vol.1).

From International ANS/ENS topical meeting on probabilistic safety methods and applications; San Francisco, CA, USA (24 Feb 1985).

The approach to safety in France has long been based on the conventional deterministic technique and hence on the defense in-depth principle. For this purpose, a set of operating conditions - normal, upset, accident conditions - considered representative, is defined and used to design the regulating, protective and engineered safety feature systems required to cope with these conditions. For the studies, the single failure criterion is taken into account. These principles are sufficient to design a unit but EDF has pursued its reflection work with the intention of improving safety. In the framework of this special effort, attention had to be focused on states which lie outside the previously defined scope and occur under conditions close to or beyond design basis conditions. These efforts have resulted in the development of operating procedures based on the use of available devices or of additional means specially designed for the so-called beyond design basis operating conditions. The first study devoted to this subject concerned the total loss of electric power supplies. The chosen methodology as well as the results obtained are presented.

30912 (EPRI-NP—3912-SR-Vol.1, pp 68.1-68.9) **System to forecast health effects in order to determine necessary counter-measures in case an accidental atmospheric release.** Merchant, T.E.; Parmentier, N. (Institut de Protection et de Surete Nucleaire, Fontenay-aux-Roses, France). Feb 1985. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $125.00. File Number TI85920509. (CONF-850206—Vol.1).

From International ANS/ENS topical meeting on probabilistic safety methods and applications; San Francisco, CA, USA (24 Feb 1985).

In most accident situations involving radioactivity, the required data are the quantitative evaluation of the relevant constituents of the release and the dose factors applicable for these constituents. In the problem of an atmospheric release of radioactivity a third group of data also comes into play, the meteorological conditions at the site and time of the accident. The solution to this problem is the construction of a computer code which, by employing acquired compositions of the release as well as physical accident conditions (at the time of the incident), can be effectively run to calculate and present useful dosimetric data. To meet this need, an interactive computer program has been constructed by the Institut de Protection et de Surete Nucleaire of the Commissariat a l'Energie Atomique which calculates the gamut of dosimetric and statistical information for a region of accidental radiological concern. Application of the program is such that it outputs dosimetric information and other important data in a form independent of the site under consideration, allowing, at the same time, the computation of the same information for areas where demographics show them to be of the highest radiological concern. All this is done after requiring minimal user input.

30913 (EPRI-NP—3912-SR-Vol.1, pp 69.1-69.15) **Natural methodology for establishing safety goal compliance requirements on a plant specific basis.** Unione, A.J.; Lim, J.J. (Lotus Reliability Associates, Inc., Los Altos, CA). Feb 1985. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $125.00. File Number TI85920509. (CONF-850206—Vol.1).

From International ANS/ENS topical meeting on probabilistic safety methods and applications; San Francisco, CA, USA (24 Feb 1985).

Defining reliability assurance criteria on a plant specific basis requires: 1) additional consideration be given to an appropriate process by which overall design objectives are translated into reliability requirements; 2) considerable flexibility be maintained in the process by which reliabilities are forecast and assured; and 3) reasonably fast and interactive techniques be developed for evaluating plant events for potential importance as contributors to a higher than acceptable level of plant safety function failures. An approach which implements these recommendations and which is cost effective for plant specific applications is advocated. This approach is based upon the following technical elements: 1) development of simplified plant risk models called macromodels which can be used to define appropriate levels of detail for reliability assurance requirements, 2) performance of calculations using the plant macromodel which assess the importance of a given set of equipment (usually a system) as a contributor to plant risk measures. 3) performance of sensitivity and uncertainty calculations which identify the potential for variability in risk measures and in system importances given that ranges or distributions of system and subsystem reliabilities are used in the macromodel; 4) the identification of high availability contributors in highly critical systems by means of system reviews of plant systems (or reviews of operating data if available).

30914 (EPRI-NP—3912-SR-Vol.1, pp 70.1-70.8) **Accident sequence identification for Indian PHWRs.** Grover, R.B.; Chakraborty, G.; Gangwal, D.K.; Mehra, V.K.; Mehta, S.K.; Babar, A.K. (Bhabha Atomic Research Center, Bombay, India). Feb 1985. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $125.00. File Number TI85920509. (CONF-850206—Vol.1).

From International ANS/ENS topical meeting on probabilistic safety methods and applications; San Francisco, CA, USA (24 Feb 1985).

In order to assess accident sequence vulnerability of PHWRs being designed in India, it was decided to identify important initiating events and to prepare event trees of such events. This paper summarizes the work done in this area and lessons learned.

30915 (EPRI-NP—3912-SR-Vol.1, pp 71.1-71.7) **Advanced design of PWR through probabilistic safety analysis.** Sobottka, H.; Fabian, H. (Kraftwerk Union AG, Offenbach, West Germany). Feb 1985. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $125.00. File Number TI85920509. (CONF-850206—Vol.1).

From International ANS/ENS topical meeting on probabilistic safety methods and applications; San Francisco, CA, USA (24 Feb 1985).

The KWU NPP is designed on the basis of deterministic oriented criteria, requirements and on a licensing procedure with a well-established set of rules, e.g. safety criteria by the German Ministry of Interior, guidelines of the German Reactor Safety Commission. Safety is achieved by carefulness of plant design, quality assurance, operation and surveillance of plant. The assurance of normal operating conditions and the prevention of incidents through control result in extraordinary plant load factors of KWU-PWR. With this background there would be no need for probabilistic analysis in licensing or for a fundamental review of the design. Nevertheless PSA are very useful to demonstrate and quantify safety margins of engineered safety features. Furthermore PSA can be used to check the existing design with respect to a balanced concept or any possibility for streamlining the concept. For this purpose a systematic reliability analysis of each active or passive function has to be performed. Then the result of these analyses have to be evaluated in connection with those incidents and accidents which influence the design. This procedure is illustrated at the following examples: accumulator injection, steam generator feeding, and reactor building design.

30916 (EPRI-NP—3912-SR-Vol.1, pp 72.1-72.11) **Demonstration uncertainty/sensitivity analysis using the health and economic consequence model CRAC2.** Alpert, D.J.; Iman, R.L.; Johnson, J.D.; Helton, J.C. (Sandia National Labs., Albuquerque, NM). Feb 1985. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $125.00. File Number TI85920509. (CONF-850206—Vol.1). Contract AC04-76DP00789.

From International ANS/ENS topical meeting on probabilistic safety methods and applications; San Francisco, CA, USA (24 Feb 1985).

This paper summarizes a demonstration uncertainty/sensitivity analysis performed on the reactor accident consequence model CRAC2. The study was performed with uncertainty/sensitivity analysis techniques compiled as part of the MELCOR program. The principal objectives of the study were: 1) to demonstrate the use of the uncertainty/sensitivity analysis techniques on a health and economic consequence model, 2) to test the computer models which implement the techniques, 3) to identify possible difficulties in performing such an analysis, and 4) to explore alternative means of analyzing, displaying, and describing the results. Demonstration of the applicability of the techniques was the motivation for performing this study; thus, the results should not be taken as a definitive uncertainty analysis of health and economic consequences. Nevertheless, significant insights on health and economic consequence analysis can be drawn from the results of this type of study. Latin hypercube sampling (LHS), a modified Monte Carlo technique, was used in this study. LHS generates a multivariate input structure in which all the variables of interest are varied simultaneously and desired correlations between variables are preserved. LHS has been shown to produce estimates of output distribution functions that are comparable with results of larger random samples.

30917 **(EPRI-NP—3975) Analysis of the hydrogen burn in the TMI-2 containment. Final report.** Zalosh, R.G.; Beier, R.A.; Dean, R.K.; Earley, M.W.; Ural, E.A. (Factory Mutual Research Corp., Norwood, MA (USA)). Apr 1985. 92p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920616.

A comprehensive analysis of the TMI-2 hydrogen deflagration is descibed encompassing hydrogen generation/release rates, hydrogen mixing prior to the burn, likely ignition sources, combustion and cool-down phenomena, and burn-induced mechanical and thermal damage. The analysis independently leads to conclusions that agree in most aspects with those reached in previous TMI burn studies. In addition, new conclusions are also reached to quantify hydrogen concentration non-uniformities; to identify a few most plausible ignition sources; to interpret peak pressures and pressure rise times in terms of turbulent flame propagation parameters; and to explain the observed minor localized mechanical damage and the thermal degradation of some exposed electrical cables.

30918 **(EPRI-NP—4033) Clad interface crack detection and sizing. Final report.** Johansen, F.P. (Sigma Research, Inc., Richland, WA (USA)). May 1985. 65p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920657.

A test program to evaluate methods of detecting cracks in sample blocks that simulate conditions and features found beneath production-type austenitic weld cladding in nuclear reactor pressure vessels has been developed. During the project, two blocks (2 feet square) were fabricated from A-533 plate steel, and multiple flaws were machined in their surfaces, which were subsequently faced with wire- and strip-cladding. The machined defects were characterized by radiography and ultrasonics. The test program includes procedures to screen multiple inspection techniques, and a statistical analysis program has been formulated to process the resulting data. An ultrasonic interferometric technique was developed to size underclad cracks, but signal-to-noise problems limited its usefulness. Continued test efforts and future sample block designs are being discussed. 89 refs., 15 figs.

30919 **(EPRI-NP—4043) Assessment of dynamic fracture mechanics for the analysis of crack arrest in a pressurized thermal shock event. Final report.** Kanninen, M.F.; Ahmad, J.; Papaspyropoulos, V.; Hudak, S.J.; FitzGerald, J.H. (Southwest Research Inst., San Antonio, TX (USA)). May 1985. 54p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920654.

The objective of this project was to assess the feasibility of a dynamic fracture mechanics approach for use in analyses of postulated pressurized thermal shock (PTS) events in nuclear pressure vessels. The work focused on a high strength steel (type 4340) and employed linear elastic fracture mechanics concepts exclusively. Four specific tasks were performed. These were to (1) conduct dynamic crack run/arrest experiments in different temperature and crack speed regimes, (2) perform generation-phase elastodynamic finite element analyses of the experiments to obtain dynamic fracture toughness properties, (3) extrapolate these results to develop an approximate representation of the dynamic fracture toughness of nuclear pressure vessel steel, and (4) use this property to compute run/arrest behavior under a typical PTS condition. It was found that the crack arrest toughness data obtained via a dynamic fracture mechanics approach was largely in agreement with the 4340 steel data obtained (in a much complex manner) by other investigators. More significantly, the feasibility of applying the procedures developed in this research for PTS analyses was conclusively demonstrated. These results also indicate that, while dynamic effects must be considered in obtaining crack arrest data from small-scale specimen testing, static analysis may suffice for evaluating crack arrest in a nuclear pressure vessel. Recommendations are given for the further research that is needed to enable practical use of the approach developed in this work. 18 refs., 20 figs., 2 tabs.

30920 **(EUR—6537) RL5SORT/RL5PLOT. A graphite package for the JRC-Ispra IBM version of RELAP5/MOD1.** Kolar, W.; Brewka, W. (Commission of the European Communities, Luxembourg; Commission of the European Communities, Ispra (Italy). Joint Research Centre). 1984. 46p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85701522.

The present report describes the programs RL5SORT and RL5PLOT, their implementation and "how to use". Both programs base on the IBM version of RELAP5 as developed at JRC-ISPRA. RL5SORT creates from the output file (restart plot file) of a RELAP5 calculation data files, which serve as input data base for the program RL5PLOT. RL5PLOT retrieves the previous stored data records (minor edit quantities of RELAP5), allows arithmetic operations with the retrieved data and enables a print or graphic output on the terminal screen of a TEKTRONIX graphic terminal. A set of commands, incorporated in the program RL5PLOT, facilitates the user's work. Program RL5SORT has been developed as a batch program, while RL5PLOT has been conceived for interactive working mode.

30921 **(EUR—6538) Implementation of the CDC version of RELAP5/MOD1/019 on an IBM compatible computer system (AMDAHL 470/V8).** Kolar, W.; Brewka, W. (Commission of the European Communities, Luxembourg; Commission of the European Communities, Ispra (Italy). Joint Research Centre). 1984. 38p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85701493.

RELAP5/MOD1 is an advanced one-dimensional best estimate system code, which is used for safety analysis studies of nuclear pressurized water reactor systems and related integral and separate effect test facilities. The program predicts the system response for large break, small break LOCA and special transients. To a large extent RELAP5/MOD1 is written in Fortran, only a small part of the program is coded in CDC assembler. RELAP5/MOD1 was developed on the CDC CYBER 176 at INEL. The code development team made use of CDC system programs like the CDC UPDATE facility and incorporated in the program special purpose software packages. The report describes the problems which have been encountered when implementing the CDC version of RELAP5/MOD1 on an IBM compatible computer systems (AMDAHL 470/V8).

30922 **(EUR—8920-Pt.1) RODSWELL: a computer code for the thermomechanical analysis of fuel rods under LOCA conditions. Part I: models and code description.** Casadei, F.; Laval, H.; Donea, J.; Jones, P.M.; Colombo, A. (Commission of the European Communities, Luxembourg; Commission of the European Communities, Ispra (Italy). Joint Research Centre). 1984. 148p. NTIS (US Sales Only), PC A07/MF A01. File Number DE85701491.

The code calculates the variation in space and time of all significant fuel rod variables, including fuel, gap and cladding temperature, fuel and cladding deformation, cladding oxidation and rod internal pressure. The code combines a transient 2-dimensional heat conduction code and a 1-dimensional mechanical model for the cladding deformation. The first sections of this report deal with the heat conduction model and the finite element discretization used for the thermal analysis. The mechanical deformation model is presented next: modelling of creep, phase change and oxidation of the zircaloy cladding is discussed in detail. A model describing the effect of oxidation and oxide cracking on the mechanical strength of the cladding is presented too. Next a mechanical restraint model, which allows the simulation of the presence of the neighbouring rods and is particularly important in assessing the amount of channel blockage during a transient, is presented. A description of the models used for the coolant conditions and for the power generation follows. The heat source can be placed either in the fuel or in the cladding, and direct or indirect clad heating by electrical power can be simulated. Then a section follows, dealing with the steady-state and transient types of calculation and with the automatic variable time step selection during the transient. The last sections deal with presentation of results, graphical output, test problems and an example of general application of the code.

30923 **(EUR—8920-Pt.2) RODSWELL: a computer code for the thermomechanical analysis of fuel rods under LOCA conditions. Part II: input manual.** Casadei, F.; Laval, H.; Donea, J.; Jones, P.M.; Colombo, A. (Commission of the European Communities, Luxembourg; Commission of the European Communities, Ispra (Italy). Joint Research Centre). 1984. 54p. NTIS (US Sales Only), PC A04/MF A01. File Number DE85701492.

The present report is the user's manual for the computer code RODSWELL developed at the JRC-Ispra for the thermomechanical analysis of LWR fuel rods under simulated loss-of-coolant accident (LOCA) conditions. The code calculates the variation in space and time of all significant fuel rod variables, including fuel, gap and cladding temperature, fuel and cladding deformation, cladding oxidation and rod internal pressure. The essential characteristics of the code are briefly outlined here. The model is particularly designed to perform a full thermal and mechanical analysis in both the azimuthal and radial directions. Thus, azimuthal temperature gradients arising from pellet eccentricity, flux tilt, arbitrary distribution of heat sources in the fuel and the cladding and azimuthal variation of coolant conditions can be treated. The code combines a transient 2-dimensional heat conduction code and a 1-dimentional mechanical model for the cladding deformation. The fuel rod is divided into a number of axial sections and a detailed thermomechanical analysis is performed within each section in radial and azimuthal directions. In the following sections, instructions are given for the definition of the data files and the semi-variable dimensions. Then follows a complete description of the input data. Finally, the restart option is described.

30924 (EUR—8955) **Gas cloud explosions and their effect on nuclear power plant. Phase 1: basic development of explosion codes.** Hall, S.F.; Martin, D.; MacKenzie, J. (Commission of the European Communities, Luxembourg). 1984. 173p. NTIS (US Sales Only), PC A08/MF A01. File Number DE85701489.

The study of factors influencing the pressure and velocity fields produced by the burning of clouds of flammable substances has been in progress in SRD for some years. During this time several computer codes have been developed to aid these studies. This report concerns an extension of these studies, which involves firstly, the use of the existing codes for systematic parameter surveys and secondly, the removal of some of the limitations on the code capabilities so that they become capable of producing more realistic representations of real explosions. This work is all aimed at the study of wave and velocity fields and the influence of rigid boundaries, such as the presence of strong buildings, e.g. nuclear power plants. These existing computer models have been used to investigate the scope and range of possible pressure loadings produced by gas cloud explosions and the interaction of their pressure fields with structures. Calculations have been undertaken for a number of different fuels and at different concentrations and burning velocities. The results of some of these calculations have been used in two-dimensional wave-structure interaction calculations with structures representative of nuclear power plant buildings. Finally, the development of a two-dimensional code capable of modelling flame and pressure wave interactions with structures is presented. This code has user-oriented input and output routines with particular attention having been paid to initial conditions, obstacles and graphics. The flux corrected transport method (the state-of-the-art method for dealing with flow with shocks) is used to solve a system of equations consisting of the usual conservation equations and a simple turbulence model (two-equation K-E model) including a simple turbulence-dependent chemical reaction rate.

30925 (EUR—9043) **Computer code EURDYN-1MP (release 1) for plane fluid-structure systems: user's manual.** Giuliani, S. (Commission of the European Communities, Luxembourg; Commission of the European Communities, Ispra (Italy). Joint Research Centre). 1984. 88p. NTIS (US Sales Only), PC A05/MF A01. File Number DE85701523.

EURDYN-1MP is a finite element computer code developed at J.R.C. Ispra to compute the response of two-dimensional, coupled fluid-structure configurations to transient dynamic loading. The structural domain is assumed to be in a situation of plane strain, but axial motion of the fluid is considered. This report gives instructions for preparing input data to EURDYN-1MP, release 1, and describes a test problem in order to illustrate both the input and the output of the code.

30926 (EUR—9101) **Influence of increasing hydrogen concentration on the heat transfer phenomena during boildown.** Shepherd, I. (Commission of the European Communities, Luxembourg). 1984. 61p. NTIS (US Sales Only), PC A04/MF A01. File Number DE85701474.

A previous paper has studied boildown transients on a single pin using a simple computer model. The computer model has now been improved to allow for the production of hydrogen by the exothermic zirconium/water reaction and this paper describes the model and studies how the previous results are changed. The same test cases were run with the new model as before; single pin boildowns at 80 bars. For the particular configuration (inlet temperature, fuel pin length, axial power distribution etc.) that was studied some conclusions were reached. Provided the cladding does not rise above melting temperature, the volume fraction of hydrogen does not rise above a value of 6%. The chief effect of the hydrogen is to reduce the thermal capacity of the coolant. Thus the clad rises to higher temperatures than would otherwise be the case. When the cladding rises above melting temperature the modelling is more approximate but there are indications that the concentration of hydrogen can rise to higher values. In these cases the oxidation reaction rate may be limited by diffusion of steam through the coolant.

30927 (EUR—9172) **Comparison of sodium aerosol codes.** Dunbar, I.H.; Fermandjian, J.; Bunz, H.; L'homme, A.; Lhiaubet, G.; Himeno, Y.; Kirby, C.R.; Mitsutsuka, N. (Commission of the European Communities, Luxembourg). 1984. 134p. NTIS (US Sales Only), PC A07/MF A01. File Number DE85701502.

Although hypothetical fast reactor accidents leading to severe core damage are very low probability events, their consequences are to be assessed. During such accidents, one can envisage the ejection of sodium, mixed with fuel and fission products, from the primary circuit into the secondary containment. Aerosols can be formed either by mechanical dispersion of the molten material or as a result of combustion of the sodium in the mixture. Therefore considerable effort has been devoted to study the different sodium aerosol phenomena. To ensure that the problems of describing the physical behaviour of sodium aerosols were adequately understood, a comparison of the codes being developed to describe their behaviour was undertaken. The comparison consists of two parts. The first is a comparative study of the computer codes used to predict aerosol behaviour during a hypothetical accident. It is a critical review of documentation available. The second part is an exercise in which code users have run their own codes with a pre-arranged input. For the critical comparative review of the computer models, documentation has been made available on the following codes: AEROSIM (UK), MAEROS (USA), HAARM-3 (USA), AEROSOLS/A2 (France), AEROSOLS/B1 (France), and PARDISEKO-IIIb (FRG).

30928 (EUR—9203) **Intercomparison test of various aerosol measurement techniques.** Cherdron, W.; Hassa, C.; Jordan, S. (Commission of the European Communities, Luxembourg). 1984. 178p. NTIS (US Sales Only), PC A09/MF A01. File Number DE85701503.

At the suggestion of the CONT group (Containment Loading and Response), which is a subgroup of the Safety Working Group of the Fast Reactor Coordinating Committee, a group of experts undertook a comparison of the techniques of sodium aerosol measurement used in various laboratories in the EC. The following laboratories took part in the exercise: CEN-Mol (Belgium), CEA-Cadarache (France), CEA-Fontenay-aux-Roses (France), KfK-Karlsruhe (Federal Republic of Germany), ENEA-Bologna (Italy), and UKAEA-Winfrith (United Kingdom). The objective of the aerosol measurement workshop was to assess the applicability and reliability of specific aerosol measuring instruments. Measurements performed with equipment from the participating laboratories were evaluated using a standard procedure. This enabled an estimate of the accuracy of the experimental data to be provided for the verification of aerosol codes. Thus these results can be used as input for the physical modelling of aerosol behaviour, and the work reported here is a contribution to the definition of the radioactive source term for severe accidents in LMFBRs. The aerosol experts participating in the exercise agreed to concentrate on the techniques of measuring aerosol particle size distributions. The tests were performed at the FAUNA test facility using the aerosol loop. A sodium spray fire, which provides a continuous aerosol source of variable concentration, was produced under open-loop conditions in this facility. Although the primary objective of the workshop was to determine the particle size distributions of the aerosols, measurements of the sodium mass concentration were also made.

30929 (IA—1404, pp 203-204) **Environmental protection as a factor in reducing the radiological effects due to an accident in a nuclear power plant.** Koch, J.; Tadmor, J. Jul 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85780940.

Published in summary form only.

In Research laboratories annual report 1983.

30930 (IAEA-TC—427/5, pp 306-311) **Problems and limitations in hydrodynamic added-mass calculations.** Pecinka, L.; Cechura, M. (Power Engineering Div., Skoda Concern, Plzen (Czechoslovakia)); Kuzelka, V. (Statni Vyzkumny Ustav pro Stavbu Stroju, Bechovice (Czechoslovakia)). Jul 1984. NTIS (US Sales Only), PC A14/MF A01. File Number TI. (CONF-8310369—; TC-SR—3).

From Specialists' meeting on experimental and modelling aspects of small-break LOCA; Budapest, Hungary (3 Oct 1983).

The problems related to the calculation of the core barrel response to a pressure shock wave generated for example by a pipe rupture or a main coolant pump rotor failure are discussed. The validity of the expressions derived for numerical solutions is verified using a simple experimental setup which is also described. The validity range for the expressions is given.

30931 (IAEA-TC—427/5, pp 170-173) **Demands on small-break LOCA codes from the licensing point of view.** Hoehn, J. (Staatliches Amt fuer Atomsicherheit und Strahlenschutz, Berlin (German Democratic Republic)). Jul 1984. NTIS (US Sales Only), PC A14/MF A01. File Number TI. (CONF-8310369—; TC-SR—3).

From Specialists' meeting on experimental and modelling aspects of small-break LOCA; Budapest, Hungary (3 Oct 1983).

The use of approved computer codes for safety analysis is required in order to increase the confidence level in licensing statements. For this purpose the regulatory body of the GDR has embarked on a programme to authorize computer codes. The different steps will be discussed for LOCA-codes suitable for the small pipe break evaluation. In a country constructing and operating nuclear power plants on the basis of imported design documents and main components, specific aspects concerning the requirements on small-break LOCA-codes have to be taken into account. Among others, the problems connected with the modelling of the typical design features of the plant and the available computer efficiencies speak well for its own code development.

30932 (IAEA-TC—427/5, pp 39-50) **Comparisons of analysis on Rosa-III Run 912 test. A BWR small break LOCA simulation.** Tasaka, K.; Koizumi, Y.; Anoda, Y.; Kumamaru, H.; Shiba, M. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Jul 1984. NTIS (US Sales Only), PC A14/MF A01. File Number TI. (CONF-8310369—; TC-SR—3).

From Specialists' meeting on experimental and modelling aspects of small-break LOCA; Budapest, Hungary (3 Oct 1983).

A relatively small number of system effect experiments are available for the evaluation of BWR LOCA/EEC computer codes as compared to PWR LOCA/ECC codes. The ROSA-III programme is one of the few experimental programmes which provide the system transient data needed for such evaluation. In 1982 a standard problem was proposed by the Japanese Atomic Energy Research Institute (JAERI) to predict thermal-hydraulic transients and compare the analytical results with experimental data. Eight research groups from Japan and abroad participated in this exercise, using TRAC-BD1, RELAP4/MOD6, RELAP5/MOD5 and RELAP4/MOD6/U/J3. The paper describes the ROSA-III test facility design, the experimental procedures used and the data achieved from Run 912, and discusses the results of the analyses performed by the various participants.

30933 (IAEA-TC—427/5, pp 145-154) **Computer code application, verification and development for small-break LOCA analysis.** Abramson, P.B. (Argonne National Lab., IL (USA)). Jul 1984. NTIS (US Sales Only), PC A14/MF A01. File Number TI. (CONF-8310369—; TC-SR—3).

From Specialists' meeting on experimental and modelling aspects of small-break LOCA; Budapest, Hungary (3 Oct 1983).

In each transient analysis there are weaknesses, created by lack of fundamental experimental data specific to that transient, which cause uncertainties in the analytical result. Each code developer has taken a different approach to dealing with those uncertainties, including correlation to special effects tests, generally conservative modelling, and conservative overall analysis. In addition to the uncertainties associated with models, there is an interaction between the models and the nodalization selection which can significantly alter the analytical results. This paper presents an overview of selected current uncertainties as they relate to Small Break Loss of Coolant Accidents (SBLOCA), and suggests potential areas for future development and verification efforts.

30934 (IAEA-TC—427/5, pp 7-24) **Synopsis of experimental activities on small-break LOCA.** Hein, D. (Kraftwerk Union A.G., Erlangen (Germany, F.R.)). Jul 1984. NTIS (US Sales Only), PC A14/MF A01. File Number TI. (CONF-8310369—; TC-SR—3).

From Specialists' meeting on experimental and modelling aspects of small-break LOCA; Budapest, Hungary (3 Oct 1983).

Through reactor safety studies like WASH 1400 or the "Deutsche Risiko-Studie" the attention has turned from large break loss of coolant accidents to small breaks because of the high contribution of this type of accidents to core meltdown. But only after the TMI-2 accident were also the main activities in the experimental fields shifted world-wide to the small break LOCAs. Since TMI numerous research programs have either been finished or are underway. This review paper presents: a classification of the various types of transients according to break size; a discussion of major physical phenomena associated with a small break LOCA, and a description of a few selected research programs and the most important results achieved.

30935 (IAEA-TC—427/5, pp 25-38) **LOBI-MOD2 small-break and special transients research.** Worth, B.; Staedtke, H.; Riebold, W.L. (Commission of the European Communities, Ispra (Italy). Joint Research Centre). Jul 1984. NTIS (US Sales Only), PC A14/MF A01. File Number TI. (CONF-8310369—; TC-SR—3).

From Specialists' meeting on experimental and modelling aspects of small-break LOCA; Budapest, Hungary (3 Oct 1983).

The present paper describes the LOBI-MOD2 Test Facility together with the experimental and analytical programmes. The MOD2 configuration was designed specifically to satisfy various simulation requirements originating from small break and special transients research objectives. These general objectives are identified, and the methods used to meet them are described.

30936 (IAEA-TC—427/5, pp 155-170) **RELAP5 user experiences.** Holmstroem, H. (Valtion Teknillinen Tutkimuskeskus, Helsinki (Finland)). Jul 1984. NTIS (US Sales Only), PC A14/MF A01. File Number TI. (CONF-8310369—; TC-SR—3).

From Specialists' meeting on experimental and modelling aspects of small-break LOCA; Budapest, Hungary (3 Oct 1983).

Several versions of the RELAP5/MOD1 computer code have been used at VTT since January, 1981. It has proved to be a valuable tool in SBLOCA studies and analyses. However, a number of deficiencies and limitations have been detected. In this paper some comparisons between calculated and experimental data are made, deficiencies and limitations discussed and user guidelines suggested.

30937 (IAEA-TC—427/5, pp 173-185) **Computer codes development and application in NPPRI to analyse small and medium LOCA.** Misak, J.; Bazso, Z.; Klepac, J. (Vyskumny Ustav Jadrovych Elektrarni, Jaslovske Bohunice (Czechoslovakia)). Jul 1984. NTIS (US Sales Only), PC A14/MF A01. File Number TI. (CONF-8310369—; TC-SR—3).

From Specialists' meeting on experimental and modelling aspects of small-break LOCA; Budapest, Hungary (3 Oct 1983).

Specific problems of small LOCA analysis are briefly discussed and basic approach used in NPPRI for this analysis is described. Three types of codes are presently used - complex primary and secondary system transient behaviour code with special attention devoted to the adequate representation of controllers, classical multinodal codes of RELAP family and special fast-running code for small LOCA analysis. Main characteristics of the codes are given and typical results of analysis are presented.

30938 (IAEA-TC—427/5, pp 192-199) **Aspects of small-break LOCA analysis using few volumes.** Eriksson, J. (Studsvik Energiteknik AB, Nykoeping (Sweden)). Jul 1984. NTIS (US Sales Only), PC A14/MF A01. File Number TI. (CONF-8310369—; TC-SR—3).

From Specialists' meeting on experimental and modelling aspects of small-break LOCA; Budapest, Hungary (3 Oct 1983).

Application problems in small-break LOCA analyses may arise when the available computer has limited capacity and when the code used, in our case the RELAP5, is rather detailed. The effect on the results due to a simplified schematic nodalization - by lumping small and differently shaped volumes and heat structures - has therefore been investigated. By applying certain lumping criteria an essential reduction in the required computer time was achieved, still having satisfactory calculation results. The insensitivity of nodalization is partly a consequence of the global conservation of mass and energy.

30939 (IAEA-TC—427/5, pp 224-236) **Pre-test analysis of PMK experiments.** Perneczky, L.; Toth, I. (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). Jul 1984. NTIS (US Sales Only), PC A14/MF A01. File Number TI. (CONF-8310369—; TC-SR—3).

From Specialists' meeting on experimental and modelling aspects of small-break LOCA; Budapest, Hungary (3 Oct 1983).

The PMK test facility, currently under construction at the Hungarian Central Research Institute for Physics (CRIP) is intended to investigate the dynamic behaviour of WWER-type pressurized water reactors, in particular during a small-break LOCA. These reactors have some unique features, such as six loops in the primary circuit, horizontal steam generators, loop seals in both the hot and the cold legs, and shrouded fuel assemblies. Pre-test calculations for the first test series and their results are presented and their influence on test facility design optimization and code modelling is discussed. The calculations were made for a one percent break in the cold leg, a 3.3 percent break of the pressurizer, and steady-state natural circulation. The codes used were RELAP4/MOD3 and MOD6.

30940 (IAEA-TC—427/5, pp 255-263) **Modelling of small-break LOCA for NPP Krsko using RELAP5/MOD1 code.** Gregoric, M. (Institut Jozef Stefan, Ljubljana (Yugoslavia)). Jul 1984. NTIS (US Sales Only), PC A14/MF A01. File Number TI. (CONF-8310369—; TC-SR—3).

From Specialists' meeting on experimental and modelling aspects of small-break LOCA; Budapest, Hungary (3 Oct 1983).

Experience with RELAP5/MOD1 code at Institute "Jozef Stefan" is discussed. Models of PWR Krsko are described with details on D-4 steam generator model. Integral system model was attempted and due to small progress replaced by lumped loops model, with basic hydraulic and thermal similarity to the plant and basic controls of pressurizer pressure and level. Separate models were constructed for steam generator, reactor, pressurizer and safety systems including plant control and protection systems. The problems encountered are outlined. Some results of the ongoing analysis are shown.

30941 (IAEA-TC—427/5, pp 264-270) **Fast simulation of small-break LOCA (SBLOCA) transients.** Miettinen, J. (Valtion Teknillinen Tutkimuskeskus, Helsinki (Finland)). Jul 1984. NTIS (US Sales Only), PC A14/MF A01. File Number TI. (CONF-8310369—; TC-SR—3).

From Specialists' meeting on experimental and modelling aspects of small-break LOCA; Budapest, Hungary (3 Oct 1983).

The pressurized water reactors (PWR) have been designed to operate in the way that normally only liquid exists in the primary circuit. In the primary break accidents, however, the primary pressure decreases as a consequence of the coolant discharge and a two-phase condition may occur. The simulation of two-phase thermohydraulics is quite complicated and demands a lot of computer resources. Large computer code packages, like RELAP5 and TRAC are aimed for small-break LOCA (SBLOCA) simulations of reactor systems. With limited computer resources the large codes are not practical, because typically a lot of computer runs with parameter variations are needed for understanding of the two-phase transients. For extensive parameter variations a simplified two-phase model SMABRE has been developed. The basic physical models are similar to those in the large simulation codes, but by making some simplifications the fast running simulation of SBLOCA is possible. The verification of the two-phase code with plant data is not possible because the accidents leading to the two-phase condition are so rare. Instead, experimental results from small scale facilities are applied. In the case of the SMABRE verification the LOFT results were used. The applications of the code include separate plant analyses. The code has been installed as a two-phase model into the Loviisa training simulator.

30942 (IAEA-TC—427/5, pp 271-277) **Numerical simulation and analysis of the Doel-2 steam generator tube rupture.** Stubbe, E.J. (Tractionel Engineering, Brussels (Belgium)). Jul 1984. NTIS (US Sales Only), PC A14/MF A01. File Number TI. (CONF-8310369—; TC-SR—3).

From Specialists' meeting on experimental and modelling aspects of small-break LOCA; Budapest, Hungary (3 Oct 1983).

A steam generator tube rupture which occurred on 2 June 1979 at the Doel-2 nuclear power plant in Belgium is analysed based on available plant recorded data and on-site computer diagnostics, with numerical simulation using the RELAP5/MOD1 computer code. The objectives were to improve understanding of the observed phenomena, to draw conclusions for procedures and system design and to assess the capabilities of the RELAP5 code. The numerical simulation of 2700 seconds of the transient is described and the conclusions drawn for the procedures and control systems are given. Also, the limitations encountered in the use of RELAP5/MOD1 are stated and solutions are presented to overcome difficulties.

30943 (IAEA-TC—427/5, pp 134-144) **Features of transients following loss-of-coolant accidents and emergency core cooling systems in pressure-tube boiling water reactors.** Volkov, V.P.; Kramerov, A.Ya.; Savvatimsky, G.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). Jul 1984. NTIS (US Sales Only), PC A14/MF A01. File Number TI. (CONF-8310369—; TC-SR—3).

From Specialists' meeting on experimental and modelling aspects of small-break LOCA; Budapest, Hungary (3 Oct 1983).

The paper presents the characteristics of a graphite moderated pressure tube boiling water reactor (PTBWR) of the RBMK 1000 type during LOCA with large and small break sizes. It discusses related thermohydraulic phenomena investigated experimentally and analytically, refers to the effects of ECCS modifications, and outlines where additional investigations are needed.

30944 (IAEA-TC—427/5, pp 93-99) **Experimental and analytical studies pertaining to small-break LOCA in Pressurised Heavy Water Reactors.** Venkat Raj, V.; Grover, R.B.; Dolas, P.K.; Mehta, S.K. (Bhabha Atomic Research Centre, Bombay (India). Reactor Engineering Div.). Jul 1984. NTIS (US Sales Only), PC A14/MF A01. File Number TI. (CONF-8310369—; TC-SR—3).

From Specialists' meeting on experimental and modelling aspects of small-break LOCA; Budapest, Hungary (3 Oct 1983).

The small-break LOCA has been a topic of worldwide discussion in the recent past. Such an accident assumes greater significance in Pressurised Heavy Water Reactors because of its higher probability. Studies are in progress pertaining to certain aspects of the blowdown and the emergency core cooling phases. These include development of instrumentation, experimental and analytical studies on blowdown, emergency coolant flow distribution and rewetting of hot horizontal channels. These are discussed in this paper.

30945 (IAEA-TC—427/5, pp 186-192) **Test models and solutions for the moderator circuit failure in PHWR Atucha I.** Goldstein, M.; Palamidessi, H.; Porto, J. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). Jul 1984. NTIS (US Sales Only), PC A14/MF A01. File Number TI. (CONF-8310369—; TC-SR—3).

From Specialists' meeting on experimental and modelling aspects of small-break LOCA; Budapest, Hungary (3 Oct 1983).

Recurrent failures due to cracks in a moderator-circuit pipe in Atucha I Nuclear Power Station were investigated. Thermal cycling fatigue was suggested as the main cause of failure by temperature values measured on the outer wall of the pipe. Suspecting the presence of stratification between cold and hot water in a turbulent zone, a test model with a transparent acrylic pipe was devised. The presence of temperature stratification and oscillation of the interface region was clearly visible, and confirmed by temperature measurements at the inner wall of the pipe. In spite of the dissimilar values of significant parameters, between operating conditions in the station and in the test model, evidence of stratification, as being the main cause of thermal fatigue and subsequent mechanical stress, seems to be rather sound. Further studies with a simplified mathematical model worked out in a digital computer, confirmed the stratification hypothesis. Possible solutions to the practical problem are briefly discussed.

30946 (IAEA-TC—427/5, pp 277-292) **CANDU LOCA experiments comparisons with the FIREBIRD-III and RELAP5 codes.** Wright, A.C.D.; Caplan, M.Z. (Atomic Energy of Canada Ltd., Mississauga, Ontario. CANDU Operations); Proto, G.; Alemberti, A.; Bimbo, G. (Nucleare Italiana Reattori Avanzati S.p.A. (NIRA), Genoa). Jul 1984. NTIS (US Sales Only), PC A14/MF A01. File Number TI. (CONF-8310369—; TC-SR—3).

From Specialists' meeting on experimental and modelling aspects of small-break LOCA; Budapest, Hungary (3 Oct 1983).

The thermohydraulics computer codes FIREBIRD-III and RELAP5 have been used to simulate a cold water injection experiment done at Westinghouse Canada Incorporated and a blowdown plus injection experiment done in the RD-12 loop at Whiteshell Nuclear Research Establishment. The cold water injection experimental facility contains two parallel horizontal CANDU-like channels, each containing a 6-m long, 37-element electrically heated bundle. RD-12 is an integrated facility containing pumps, boilers and two electrically heated test sections in a CANDU-like figure-of-eight configuration. Parametric trends have been studied by simulating several additional cold water injection experiments using FIREBIRD-III. The predictions of the two codes are compared to measurements. Overall, the predictions are reasonable, although some discrepancies occur. FIREBIRD-III predicts channel refill time well at high injection pressure; however, it underpredicts channel refill time at low injection pressure. RELAP5 predicts channel refill time well for the low pressure test. Oscillations observed during refilling are qualitatively predicted by RELAP5, although the amplitude and frequency are overpredicted.

30947 (IAEA-TC—427/5, pp 293-305) **Method for assessing reactor core cooling without forced circulation.** Midvidy, W.I.; Pauls, R.E.; Sergejewich, P. (Ontario Hydro, Nuclear Studies and Safety Dept., Toronto (Canada)). Jul 1984. NTIS (US Sales Only), PC A14/MF A01. File Number TI. (CONF-8310369—; TC-SR—3).

From Specialists' meeting on experimental and modelling aspects of small-break LOCA; Budapest, Hungary (3 Oct 1983).

Under some of the postulated accidents of the CANDU PHWR, electrical power to the heat transport (HT) pumps may be interrupted resulting in the loss of forced circulation. Experiments and analyses indicate the existence of two modes of natural circulation which can provide adequate core cooling at decay power levels. These are thermosyphoning (single-phase or two-phase) and intermittent buoyancy induced flow (IBIF). A lumped parameter IBIF model, for application to heat removal below the headers, is developed and verified against pertinent experimental data. For heat transport above the headers, the various mechanisms and limiting phenomena are addressed.

30948 (IAEA-TC—427/5, pp 311-317) **Thermosyphoning in the CANDU reactor.** Spinks, N.J.; Wright, A.C.D.; Caplan, M.Z.; Prawirosoehardjo, S. (Atomic Energy of Canada Ltd., Sheridan Park, Ontario. CANDU Operations). Jul 1984. NTIS (US Sales Only), PC A14/MF A01. File Number TI. (CONF-8310369—; TC-SR—3).

From Specialists' meeting on experimental and modelling aspects of small-break LOCA; Budapest, Hungary (3 Oct 1983).

Thermosyphoning is defined as the natural convective flow of primary coolant over the boilers. It is the predicted mode of heat transport from core to boilers in many postulated scenarios for CANDU reactor safety analysis. Loss of pumping of the primary coolant is a common feature and reactor power is invariably at decay power prior to the end of pump rundown. The scenarios encompass a wide range of primary coolant inventories and secondary side conditions. CANDU primary pumps are provided with high inertia flywheels which, on loss of electrical supply, provide a forced flow of coolant whilst power is reduced to decay level. Subcooled (single-phase) thermosyphoning is predicted for this and the more probable accident scenarios. Single-phase thermosyphoning tests are done during commissioning of CANDU reactors. Recent tests at Gentilly-2 and Point Lepreau have confirmed predictions for the 600 MW(e) design. Boiling (two-phase) thermosyphoning is predicted either under reduced primary coolant inventory conditions or if the coolant make-up system is inoperative during boiler depressurization. In the latter case a pressurizer compensates, in part, for shrinkage of the primary coolant as it cools down. In any event, two-phase thermosyphoning is predicted for the less probable accident scenarios only. The paper describes the important thermohydraulic characteristics of thermosyphoning in CANDU reactors, as predicted by a transient thermohydraulics computer code, and describes experiments done for the purpose of verifying these predictions.

30949 (IKE—2-67) **Development of a mathematical model for studying rewetting of reactor fuel elements after a loss-of-coolant accident.** Schuetzle, R. (Stuttgart Univ. (Germany, F.R.). Inst. fuer Kernenergetik und Energiesysteme). 15 Oct 1984. 213p. (In German). NTIS (US Sales Only), PC A10/MF A01. File Number DE85751143.

Thesis.

The ZETHYF model allows studying the flow, heat transmission and temperature conditions in a cooling channel and, thus, rewetting of reactor fuel elements. Coolant flow is calculated for a single-phase or dual-phase coolant along coolant channel on the assumption of constant pressure. Within dual-phase flow, a thermodynamically balanced slip flow is assumed for small steam volume proportions and saturation temperature is assumed for water still existing in the form of droplets. Droplet velocity is represented by means of a momentum balance between steam and droplet, evaporation of droplets is established by means of heat supply from steam, cladding tube wall and by thermal radiation. Minimum film boiling temperature is taken as a criterium for secretting and is compared with local cladding tube temperature which is established by way of a 2-D thermal conduction equation check calculation of experiments (Flecht) yielded sufficient agreement. Calculation results yielded a somewhat slower cooling of heating element and, consequently, delayed rewetting.

30950 (INFO—0089) **Comparison of deterministic and stochastic techniques for estimation of design basis floods for nuclear power plants.** Solomon, S.I.; Harvey, K.D.; Asmis, G.J.K. (Atomic Energy Control Board, Ottawa, Ontario (Canada)). Dec 1982. 21p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85701234.

The IAEA Safety Guide 50-SG-S10A recommends that design basis floods be estimated by deterministic techniques using probable maximum precipitation and a rainfall runoff model to evaluate the corresponding flood. The Guide indicates that stochastic techniques are also acceptable in which case floods of very low probability have to be estimated. The paper compares the results of applying the two techniques in two river basins at a number of locations and concludes that the uncertainty of the results of both techniques is of the same order of magnitude. However, the use of the unit hydrograph as the rainfall runoff model may lead in some cases to nonconservative estimates. A distributed non-linear rainfall runoff model leads to estimates of probable maximum flood flows which are very close to values of flows having a 10^6 - 10^7 years return interval estimated using a conservative and relatively simple stochastic technique. Recommendations on the practical application of Safety Guide 50-SG-10A are made and the extension of the stochastic technique to ungauged sites and other design parameters is discussed.

30951 **(INFO—0115) Consequences of pressure tube rupture on in-core components. Phase 1 - technology review.** Hill, P.G.; Hauptmann, E.G.; Lee, V. (Atomic Energy Control Board, Ottawa, Ontario (Canada)). Dec 1982. 186p. NTIS (US Sales Only), PC A09/MF A01. File Number DE85701246.

An investigation has been made of the consequences of pressure tube rupture in calandria vessels of heavy water cooled and moderated reactors. The study included a review of previous experimental and analytical work, as well as supplementary investigations carried out to examine the validity of previous assumptions and findings. The central questions considered were: the possibility of a propagating pressure tube failure; damage to the calandria vessel; and damage to the shut-off-rod guide tubes of the reactor shutdown system. The results of the investigation do not indicate mechanisms of sufficient strength to cause propagating failure in a well-designed, well-operated reactor following a tube burst under normal operating conditions. However, not all the details of the physical processes involved in a tube burst have been revealed by existing experimental and analytical work.

30952 (INIS-mf—9532, pp 113-114) **Isolation of small malfunctions in a PWR power plant.** Covaliu, Z. (Israel Atomic Energy Commission, Tel Aviv. Licensing Div.); Ben-Haim, Y. (Technion-Israel Inst. of Tech., Haifa. Dept. of Nuclear Engineering). 1983. NTIS (US Sales Only), PC A14/MF A01. File Number DE85780892. (CONF-831241—Summ.).

From Joint US/Israeli meeting on safety and siting problems for power reactors in a small country; Haifa, Israel (20 Dec 1983).

Published in summary form only.

30953 **(JAERI-M—83-169) Users' manual for the FTA-J (Fault Tree Analysis-JAERI) code system.** Ishigami, Tsutomu; Watanabe, Norio; Hikawa, Michihiro; Kaneki, Hiroshi; Horii, Hideo; Sasaki, Shinobu. (Japan Atomic Energy Research Inst., Tokyo). Nov 1983. 164p. (In Japanese). NTIS (US Sales Only), PC A08/MF A01. File Number DE85701120.

This report provides the information needed to use the FTA-J (Fault Tree Analysis - JAERI) code system, which is designed for systematic fault tree analysis and evaluation. Several released computer codes for the fault tree analysis have been introduced, modified and consolidated. The first version is completed and now in practical use. The code system has a data base for component failure data information and interface files between the computer codes. Using the FTA-J code system, we can perform fault tree analysis including qualitative and quantitative evaluation systematically and efficiently.

30954 **(Juel-Spez—275) Evaluation of radiation doses in the surroundings of the THTR-300 caused by a hypothetical core heat-up accident.** Fassbender, J.; Kroeger, W.; Rehm, W.; Wolters, J.; Verfondern, K.; Geiss, H. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Nukleare Sicherheitsforschung). Sep 1984. 35p. (In German). NTIS (US Sales Only), PC A03/MF A01. File Number DE85751644.

As a characteristic accident sequence causing the maximum consequences, a sudden irreparable loss of core cooling at full power was assumed. This causes a slow increase in the temperature of the reactor core and the coolant gas pressure. In addition it is assumed that the gas cleaning plant fails, and that the safety valve does not shut again after it has been opened by the rising coolant gas pressure 8 hours after the initiation of the accident. This sequence of events results in a slow loss of coolant gas accompanied by an unfiltered release of radioactivity through the stack lasting about two days. The expected frequency of such an accident is less than 10^{-6}/year. When the safety valve opens, mainly noble gases and iodine will be released at first. Cesium and strontium only follow after more than 30 and 50 hours, respectively. The radiation doses were pessimistically estimated for an exposure time of 7 days. The thyroid dose nowhere exceeds 25 rem, if the consumption of contaminated food is forbidden within 8 hours after the beginning of the accident. The whole body dose is mainly caused by the inhalation of strontium. It does not exceed 5 rem and therefore does not reach the upper limit of the lowest hazard class by far. This is also true of the bone dose. The estimated doses are to be considered as a kind of upper limit values which in case of a real accident would not be reached by far. In any case the development of the accident leaves ample time for an analysis of the accident situation, the measurement of the actual radiation, and the initiation of adequate counter measures.

30955 **(KFK—3500) Nuclear Safety Project.** (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Nukleare Sicherheit). Nov 1984. 99p. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE85751133.

The semiannual progress report 1984/1 is a description of work within the Nuclear Safety Project performed in the first six month of 1984 in the nuclear safety field by KfK institutes and departements and by external institutions on behalf of KfK. The chosen kind of this report is that of short summaries, containing the topics work performed, results obtained and plans for future work. This report was compiled by the project management.

30956 **(LA-UR—85-457) Thermal hydraulics of a feedwater pipe breakage with a back-pressure check valve.** Travis, J.R.; Torrey, M.D. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 22p. (CONF-851103—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE85007703.

From International symposium on fundamental aspects of gas-liquid flows; Miami, FL, USA (17 Nov 1985).

The SOLA-LOOP computer code for transient, nonequilibrium, two-phase flows in networks has been coupled with a dynamic check valve model. Transient back-pressure check valve behavior and fluid dynamic effects in the form of the so called waterhammer are numerically simulated for a feed-water pipe breakage accident. Three tests from the Superheated Steam Reactor Safety Program Project (PHDR) carried out near Frankfurt, West Germany are analyzed, and the calculated transient back-pressure check valve behavior and fluid dynamics effects are found to be in excellent agreement with the experimentally measured data. 5 refs., 15 figs., 4 tabs.

30957 **(LA-UR—85-558) Vital areas at nuclear power plants.** Cameron, D.F. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 14p. (CONF-850723—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85007665.

From 7. international system safety conference; San Jose, CA, USA (25 Jul 1985).

Vital area analysis of nuclear power plants has been performed for the Nuclear Regulatory Commission by the Los Alamos National Laboratory from the late 1970's through the present. The Los Alamos Vital Area Study uses a fault-tree modeling technique to identify vital areas and equipment at nuclear power plants to determine their vulnerability. This technique has been applied to all operating plants and approximately one-half of those under construction in the US. All saboteur-induced loss-of-coolant accidents and transients and the systems needed to mitigate them are considered. As a result of this effort, security programs at nuclear power plants now include vulnerability studies that identify targets in a systematic manner, and thus unnecessary protection has been minimized. 1 ref., 8 figs., 1 tab.

30958 **(LA-UR—85-1264) Faster-than-real-time simulation of nuclear reactor accidents: the TRAC-NPA code.** Woodruff, S.B. (Los Alamos National Lab., NM (USA)). Apr 1985. Contract W-7405-ENG-36. 11p. (CONF-8504123—1). NTIS, PC A02/MF A01 - GPO; GPO Dep. File Number TI85010710.

From Cray science and engineering symposium; Bloomington, MN, USA (14 Apr 1985).

A reactor safety code that provides faster-than-real-time capabilities greatly enhances the effectiveness of an analyst. We have developed a new version of the Transient Reactor Analysis Code, TRAC-NPA, which is capable of running many one- and three-dimensional transients faster than real time on current computers. TRAC is an Eulerian finite-difference code designed to model transient, two-phase, multidimensional, steam-water flow in nuclear reactors. TRAC-NPA is fast running both because it employs the efficient stability-enhancing two-step (SETS) numerical method and because much of the coding is vectorized. TRAC-NPA has been coupled to an interactive graphics executive to create a version of the Nuclear Plant Analyzer. The features of the executive include instantaneous user-friendly display of calculational results, replay, restart with parameter variation, and interactive simulation of operator actions. The graphics executive thus provides an interface that can further enhance the effectiveness of an analyst when the underlying safety code provides faster-than-real-time simulation.

30959 (LPA-P—3) Sizewell 'B' public inquiry. Proof of evidence on safety issues. Leslie, D.C. (Suffolk County Council, Ipswich (UK); Suffolk Coastal District Council, Woodbridge (UK)). Mar 1983. 184p. British Library Lending Division, Boston Spa, Wetherby, LS23 7BQ.

The report is in sections, entitled: introduction; scope of proof; the requirements of the local authorities; the roles of CEGB and NII; the Board's radiological targets; safety in normal operation; design basis faults; the analysis of faults beyond the design basis; special concerns relating to BDBFs (operator actions and responses; selected external hazards; integrity of the primary circuit; steam generator tube integrity; performance of the containment); decommissioning.

30960 (LPA-P—5) Sizewell 'B' public inquiry. Proof of evidence on assessment of the P.S.A.s made for Sizewell 'B'. Sayles, R.S. (Suffolk County Council, Ipswich (UK); Suffolk Coastal District Council, Woodbridge (UK)). Apr 1983. 55p. British Library Lending Division, Boston Spa, Wetherby, LS23 7BQ.

The report is in sections, entitled: introduction; scope of proof; method of working; the techniques of probabilistic safety analysis; the reliability data; the treatment of common cause and common mode failure; event tree analysis employing revised CMF data; the treatment of human error.

30961 (NUREG—0090-Vol.7-No.4) Report to Congress on abnormal occurrences, October-December 1984. Volume 7, No. 4. (Nuclear Regulatory Commission, Washington, DC (USA). Office for Analysis and Evaluation of Operational Data). May 1985. 36p. NTIS, PC A03/MF A01 - GPO. File Number TI85901540.

The report states that for this report period, there were two abnormal occurrences at the nuclear power plants licensed to operate. One involved four control rods failing to insert during testing and the other involved degraded upper head injection system accumulator isolation valves. There was one abnormal occurrence at a fuel cycle facility; the event involved buildup of uranium in a ventilation system. There was one abnormal occurrence reported by an Agreement State; the event involved an overexposure of a radiographer trainee. The report also contains information updating some previously reported abnormal occurrences.

30962 (NUREG—0675-Suppl.31) Safety Evaluation Report related to the operation of Diablo Canyon Nuclear Power Plant, Units 1 and 2 (Docket Nos. 50-275 and 50-323). Supplement No. 31. (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Apr 1985. 173p. NTIS, PC A08/MF A01 - GPO. File Number TI85901371.

Supplement 31 to the Safety Evaluation Report for the application by Pacific Gas and Electric Company for a license to operate Diablo Canyon Nuclear Power Plant Unit 2 (Docket 50-323) has been prepared by the Office of Nuclear Reactor Regulation of the US Nuclear Regulatory Commission. This supplement addresses a number of matters related to the issuance of an operating license for Diablo Canyon Unit 2, in particular issues identified by the NRC staff in earlier supplements, commitments made by the applicant and certain license conditions to be included in the Unit 2 operating license.

30963 (NUREG—0797-Suppl.10) Safety Evaluation Report related to the operation of Comanche Peak Steam Electric Station, Units 1 and 2 (Docket Nos. 50-445 and 50-446). Supplement No. 10. (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Apr 1985. 329p. NTIS, PC A15/MF A01 - GPO. File Number TI85900972.

This Supplement provides the results of the staff's evaluation and resolution of approximately 400 technical concerns and allegations in the mechanical and piping area regarding construction practices at the Comanche Peak facility. This report does not address the Walsh/Doyle allegations regarding deficiencies in the pipe support design process and the new allegations recently received by the staff.

30964 (NUREG—0797-Suppl.11) Safety Evaluation Report related to the operation of Comanche Peak Steam Electric Station, Units 1 and 2 (Docket Nos. 50-445 and 50-446). Supplement No. 11. (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). May 1985. 347p. NTIS, PC A15/MF A01 - GPO. File Number TI85901541.

Supplement 11 to the Safety Evaluation Report for the Texas Utilities Electric Company application for a license to operate Comanche Peak Steam Electric Station, Units 1 and 2 (Docket Nos. 50-445, 50-446), located in Somervell County, Texas, has been jointly prepared by the Office of Nuclear Reactor Regulation and the Comanche Peak Technical Review Team (TRT) of the US Nuclear Regulatory Commission (NRC) and is in two parts. Part 1 (Appendix 0) of this supplement provides the results of the TRT's evaluation of approximately 124 concerns and allegations relating specifically to quality assurance and quality control (QA/QC) issues regarding construction proctices at the Comanche Peak facility. Part 2 (Appendix P) contains an overall summary and conclusion of the QA/QC aspects of the NRC Technical Review Team efforts as reported in supplemental Safety Evaluation Report SERs 7, 8, 9, and 10. Since QA/QC issues are also contained in each of the other supplements, the TRT considered that such a summary and conclusion from all supplements was necessary for a complete TRT description of QA/QC activities at Comanche Peak.

30965 (NUREG—0857-Suppl.8) Safety Evaluation Report related to the operation of Palo Verde Nuclear Generating Station, Units 1, 2, and 3 (Docket Nos. STN 50-528, STN 50-529, and STN 50-530). Supplement No. 8. (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). May 1985. 35p. NTIS, PC A03/MF A01 - GPO. File Number TI85901545.

Purpose of this supplement is to update the Safety Evaluation Report by providing an evaluation of additional information submitted by the applicant since Supplement No. 7 was issued and matters that the staff had under review when Supplement No. 7 was issued, specifically those issues which required resolution prior to plant operation of Unit 1 above 5% full power.

30966 (NUREG—0991-Suppl.4) Safety Evaluation Report related to the operation of Limerick Generating Station, Units 1 and 2 (Docket Nos. 50-352 and 50-353). Supplement No. 4. (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). May 1985. 48p. NTIS, PC A03/MF A01 - GPO. File Number TI85901359.

In August 1983 the staff of the Nuclear Regulatory Commission issued its Safety Evaluation Report (NUREG-0991) regarding the application of the Philadelphia Electric Company (the applicant) for licenses to operate the Limerick Generating Station, Units 1 and 2 located on a site in Montgomery and Chester Counties, Pennsylvania. A license (NPF-27) for the operation of Limerick Unit 1 was issued on October 26, 1984. The license, which was restricted to a five percent power level, contained conditions which required resolution prior to proceeding beyond the five percent power level. This Supplement 4 to the SER addresses some of those technical issues and their associated license conditions which require resolution prior to proceeding beyond the five percent power level. The remaining issues to be addressed prior to proceeding beyond the five percent power level will be addressed in a later supplement to this report. This Supplement 4 to the SER also contains the comments made by the Advisory Committee on Reactor Safeguards in its report dated November 6, 1984, regarding full power operation of Limerick Unit 1.

30967 **(NUREG—1032) Evaluation of Station Blackout accidents at nuclear power plants. Technical findings related to Unresolved Safety Issue A-44. Draft report for comment.** Baranowsky, P.W. (Nuclear Regulatory Commission, Washington, DC (USA)). May 1985. 198p. NTIS, PC A09/MF A01 - GPO. File Number TI85901551.

"Station Blackout," which is the complete loss of alternating current (ac) electrical power in a nuclear power plant, has been designated as Unresolved Safety Issue A-44. Because many safety systems required for reactor core decay heat removal and containment heat removal depend on ac power, the consequences of a station blackout could be severe. This report documents the findings of technical studies performed as part of the program to resolve this issue. The important factors analyzed include: the frequency of loss of offsite power; the probability that emergency or onsite ac power supplies would be unavailable; the capability and reliability of decay heat removal systems independent of ac power; and the likelihood that offsite power would be restored before systems that cannot operate for extended periods without ac power fail, thus resulting in core damage. This report also addresses effects of different designs, locations, and operational features on the estimated frequency of core damage resulting from station blackout events.

30968 **(NUREG—1037) Containment performance working group report. Draft report for comment.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering). May 1985. 317p. NTIS, PC A14/MF A01 - GPO. File Number TI85900970.

Containment buildings for power reactors have been studied to estimate their leak rate as a function of increasing internal pressure and temperature associated with severe accident sequences involving significant core damage. Potential leak paths through containment penetration assemblies (such as equipment hatches, airlocks, purge and vent valves, and electrical penetrations) have been identified and their contributions to leak area for the containment are incorporated into containment response analyses of selected severe accident sequences to predict the containment leak rate and pressure/temperature response as a function of time. Because of lack of reliable experimental data on the leakage behavior of containment penetrations and isolation barriers at pressures beyond their design conditions, an analytical approach has been used to estimate the leakage behavior of components found in specific reference plants that approximately characterize the various containment types.

30969 **(NUREG—1038-Suppl.2) Safety Evaluation Report related to the operation of Shearon Harris Nuclear Power Plant, Unit No. 1 (Docket No. STN 50-400). Supplement No. 2.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Jun 1985. 62p. NTIS, PC A04/MF A01 - GPO. File Number TI85901567.

This report, Supplement No. 2 to the Safety Evaluation Report for the application filed by the Carolina Power and Light Company and North Carolina Eastern Municipal Power Agency (the applicants) for a license to operate the Shearon Harris Nuclear Power Plant Unit 1 (Docket No. 50-400), has been prepared by the Office of Nuclear Reactor Regulation of the US Nuclear Regulatory Commission. This supplement reports the status of certain items that had not been resolved at the time of publication of the Safety Evaluation Report and Supplement No. 1.

30970 **(NUREG—1095) Evaluation of responses to IE Bulletin 82-02: degradation of threaded fasteners in reactor coolant pressure boundary of pressurized-water-reactor plants.** Anderson, W.; Sterner, P. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Emergency Preparedness and Engineering Response). May 1985. 89p. NTIS, PC A05/MF A01 - GPO. File Number TI85901547.

IE Bulletin 82-02 was issued by the NRC on June 2, 1982, to notify licensees about incidents of severe degradation of threaded fasteners. The bulletin required appropriate action including submittal of information from pressurized water reactors having an operating license. Responses from 41 licensees included their recent experience with degradation of threaded fasteners in primary system components. Data from recent regular inspections of reactor coolant pressure boundary component connections of 6-in. size and larger are compiled for technical evaluation. Statistical analysis is used to determine significant factors related to frequency of leakage incidents in connections, occurrence of degradation of bolts and studs, and the need for bolt replacement. Factors examined include the age of the plant, types of components, use of lubricants and sealants, and differences between plants. The compiled data indicate that, on the average, 10% of the bolted connections show evidence of leaking during an 18-month period. Also, 80% of the connections that show evidence of leakage undergo some degradation of the bolting. Results of the analysis show a significant decrease in the occurrence of bolting degradation events as the age of the plant increases. The data also show that valves are less subject to bolting corrosion. A group of 5 of the 41 plants accounted for about one-half of the reported leakage and corrosion events. The common characteristic found for four of these five plants was the lubricant used. The use of nickel-graphite based lubricants appears to offer a significantly reduced incidence of leakage and corrosion, based on late corrections to the reported data. The data also permit the conclusion that the use of molybdenum-disulfide-based lubricants and graphite-based lubricants results in a significantly increased incidence of leakage and corrosion. Reporting of data on lubricants was of poor quality and detracted from the value of the bulletin responses.

30971 **(NUREG—1119) Safety Evaluation Report related to renewal of the operating license for the CAVALIER Training Reactor at the University of Virginia (Docket No. 50-396).** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). May 1985. 62p. NTIS, PC A04/MF A01 - GPO. File Number TI85901502.

This Safety Evaluation Report for the application filed by the University of Virginia for a renewal of Operating License R-123 to continue to operate the CAVALIER (Cooperatively Assembled Virginia Low Intensity Educational Reactor) has been prepared by the Office of Nuclear Reactor Regulation of the US Nuclear Regulatory Commission. The facility is owned and operated by the University of Virginia and is located on the campus in Charlottesville, Virginia. Based on its technical review, the staff concludes that the reactor facility can continue to be operated by the university without endangering the health and safety of the public or the environment.

30972 **(NUREG—1135) Safety Evaluation Report related to the construction permit and operating license for the research reactor at the University of Texas (Docket No. 50-602).** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). May 1985. 86p. NTIS, PC A05/MF A01 - GPO. File Number TI85901542.

This Safety Evaluation Report for the application filed by the University of Texas for a construction permit and operating license to construct and operate a TRIGA research reactor has been prepared by the Office of Nuclear Reactor Regulation of the US Nuclear Regulatory Commission. The facility is owned and operated by the University of Texas and is located at the university's Balcones Research Center, about 7 miles (11.6 km) north of the main campus in Austin, Texas. The staff concludes that the TRIGA reactor facility can be constructed and operated by the University of Texas without endangering the health and safety of the public.

30973 (NUREG/CP—0058-Vol.2, pp 5-15) **TRAC-PF1 analyses of potential pressurized-thermal-shock transients at a Combustion-Engineering PWR.** Koenig, J.E.; Smith, R.C. (Los Alamos National Lab., NM). Jan 1985. NTIS, PC A20/MF A01 - GPO $9.00. File Number TI85900642. (CONF-8410142—Vol.2).

From 12. water reactor safety research information meeting; Gaithersburg, MD, USA (23 Oct 1984).

Los Alamos National Laboratory participated in a program to assess the risk of a pressurized thermal shock (PTS) to the reactor vessel during a postulated overcooling transient in a pressurized water reactor (PWR). Using the Transient Reactor Analysis Code (TRAC), Los Alamos studied the thermal-hydraulic behavior of the three following accident categories: steamline breaks, runaway-feedwater transients, and small-break loss-of-coolant accidents. These accidents were simulated for a Combustion-Engineering (C-E) PWR, Calvert Cliffs, and included multiple operator and equipment failures. The results will be used by Oak Ridge National Laboratory (ORNL) to determine the vessel wall temperature and pressure predicted by TRAC. The study identified the importance of the initial plant conditions and loop flows to the PTS issue. ORNL will extend the results of the Los Alamos study by determining the probability of vessel failure and accident occurrence for an overall assessment of PTS risk.

30974 (NUREG/CP—0058-Vol.2, pp 55-76) **Buoyancy effects in overcooling transients.** Theofanous, T.G.; Iyer, K. (Purdue Univ., Lafayette, IN). Jan 1985. NTIS, PC A20/MF A01 - GPO $9.00. File Number TI85900642. (CONF-8410142—Vol.2).

From 12. water reactor safety research information meeting; Gaithersburg, MD, USA (23 Oct 1984).

This presentation is a short report on Purdue University's contribution to the NRC pressurized thermal shock (PTS) study. Our task was to include stratification/thermal-mixing effects in the thermal-hydraulic scenarios developed by TRAC and RELAP5 calculations. The results from our study provided the input to the fracture mechanics calculations carried out at ORNL. A method was previously presented for predicting the onset of stratification in the cold leg due to HPI. Use of these criteria with the thermal-hydraulic behavior predicted by TRAC and RELAP5 leads to the conclusion that the only practically significant situation where stratification need to be considered is that involving loop flow stagnation. Of principal interest are, therefore, transients leading to complete flow stagnation. The Calvert Cliffs analyses by TRAC have also shown that an asymmetric downcomer condition, obtained by flow stagnation in only one or two of the loops, is also possible. It has been demonstrated that the basic analyses tools developed for the fully stagnated case can be fruitfully employed to address the asymmetric situations also. The analysis was based on the regional mixing model (RMM) and the associated computer code REMIX. These analytical tools were supported by reactor-specific simulations in Purdue's one-half scale PTS facility.

30975 (NUREG/CP—0058-Vol.2, pp 77-88) **Integrated pressurized thermal shock (IPTS) program probabilistic fracture-mechanics analysis and results.** Cheverton, R.D.; Ball, D.G. (Oak Ridge National Lab., TN). Jan 1985. NTIS, PC A20/MF A01 - GPO $9.00. File Number TI85900642. (CONF-8410142—Vol.2). Contract AC05-84OR21400.

From 12. water reactor safety research information meeting; Gaithersburg, MD, USA (23 Oct 1984).

The pressurized-thermal-shock (PTS) issue is concerned with the possibility of failure of a PWR pressure vessel during a transient that subjects the vessel to severe thermal shock. The ingredients necessary for failure to occur are (1) the occurrence of the transient, (2) the presence of a sharp, cracklike defect (flaw) on the inner surface, (3) exposure of the vessel wall to high fast-neutron fluxes, and (4) high concentrations of copper and nickel. The overall estimated frequency of vessel failure is determined by postulating appropriate transients, estimating their frequency of occurrence, and calculating the probability, P(F/E), of vessel failure for each of these transients. The probabilistic fracture-mechanics (PFM) model used for estimating P(F/E) and the scope and results of the fracture-mechanics studies for the Integrated Pressurized Thermal-Shock (IPTS) Program are the subject of this paper. The scope of the PFM studies includes estimates of (1) P(F/E) for reactor pressure vessels similar to those at Oconee-I, Calvert Cliffs-1, and H. B. Robinson-2, using PTS transients postulated for these plants; (2) the effect of including warm prestressing (WPS) in the calculation of P(F/E); (3) the sensitivity of P(F/E) to fracture toughness, radiation damage, and the primary-system temperature and pressure transients; and (4) the benefit of specific suggested remedial measures (reduction in fluence rate, application of in-service inspection, limit on repressurization, and annealing).

30976 (NUREG/CP—0058-Vol.2, pp 136-147) **Consequence evaluation for pressurized thermal shock.** Barrett, R.J.; Throm, E.D. (Nuclear Regulatory Commission, Washington, DC). Jan 1985. NTIS, PC A20/MF A01 - GPO $9.00. File Number TI85900642. (CONF-8410142—Vol.2).

From 12. water reactor safety research information meeting; Gaithersburg, MD, USA (23 Oct 1984).

The purpose of this paper is to illustrate the logic and methods required to estimate the societal consequences of a large break LOCA resulting from pressurized thermal shock (PTS). The analysis includes an assessment of containment response, radionuclide behavior and offsite consequences. The intent is to demonstrate the type of analysis that might be performed for a plant that is approaching the PTS screening criterion. Much of the data and many of the assumptions used in the analysis are based on experience with previous risk studies. Hence, the results are approximate. The containment and site characteristics are intended to model Oconee Unit 1, a plant for which the frequency and phenomenology of PTS events have been studied in some detail. For the purpose of this paper, it has been assumed that events lead to core melt. Given a core melt, the estimation of risk involves several major steps. First one must define the plant damage state, which describes the status of the primary system and major safety systems. Based on the plant damage states one can deduce the containment response and the magnitude of the radiological releases. Finally, using the calculated releases, the offsite consequences are estimated.

30977 (NUREG/CP—0058-Vol.2, pp 266-305) **Investigation of dispersed flow heat transfer phenomena and assessment of TRAC-PF1/MOD1 heat transfer correlations.** Vojtek, I. (Gesellschaft fuer Reaktorsicherheit mbH, Garching, West Germany). Jan 1985. NTIS, PC A20/MF A01 - GPO $9.00. File Number TI85900642. (CONF-8410142—Vol.2).

From 12. water reactor safety research information meeting; Gaithersburg, MD, USA (23 Oct 1984).

The objectives of this research effort are two-fold: 1) Assessment and improvement of existing TRAC-PF1/MOD heat transfer model. The first part of this investigation has been performed using a Driver computer code. The driver program BOILTRC consists of all TRAC-PF1/MOD1 heat transfer and properties routines and calculates heat transfer coefficients in all TRAC heat transfer regimes as a function of independent variables. The next part of the assessment that was focused mainly at the post-CHF heat transfer regime has been performed using TRAC PF1/MOD1 computer code for the post-test analysis of simple separate effects heat transfer experiments. 2) Evaluation of alternative post-CHF heat transfer models. Three different post-CHF heat transfer models were implemented into the TRAC PF1/MOD1 and have been applied for the calculation of wall-mixture heat transfer components.

30978 (NUREG/CP—0058-Vol.2, pp 306-341) **Results of CCTF upper plenum injection tests.** Murao, Y.; Iguchi, T.; Okabe, K.; Sugimoto, J.; Akimoto, H.; Okubo, T. (Japan Atomic Energy Research Institute, Tokyo). Jan 1985. NTIS, PC A20/MF A01 - GPO $9.00. File Number TI85900642. (CONF-8410142—Vol.2).

From 12. water reactor safety research information meeting; Gaithersburg, MD, USA (23 Oct 1984).

By using the Cylindrical Core Test Facility (CCTF), many tests have been performed in Japan Atomic Energy Research Institute (JAERI) in order to investigate the thermo-hydrodynamic phenomena in the refill and reflood phase during a PWR-LOCA. Most of tests have been conducted by using cold leg injection (CLI) type ECCS for three- or four-loop PWRs. Some two-loop PWRs, however, equip the upper plenum injection (UPI) type ECCS instead of CLI type ECCS. The following two possibilities are considered in the UPI type ECCS. (1) The larger steam binding and the resultant poorer core cooling appears than those in referential CLI type ECCS. (2) The higher upper plenum injection rate causes the poorer core cooling in the UPI type ECCS. In order to investigate the possibilities, two UPI tests were performed. One was a test under no failure assumption of two low pressure coolant injection pumps, and the other was a test under a single failure assumption. The results from two UPI tests and a referential single failure CLI test are compared and analyzed.

30979 (NUREG/CP—0058-Vol.2, pp 342-372) **Status of CCTF/SCTF test programs.** Murao, Y.; Adachi, H.; Iguchi, T.; Sobajima, M.; Okabe, K.; Sugimoto, J.; Akimoto, H.; Iwamura, T.; Okubo, T.; Abe, Y. (Japan Atomic Energy Research Institute, Tokyo). Jan 1985. NTIS, PC A20/MF A01 - GPO $9.00. File Number TI85900642. (CONF-8410142—Vol.2).

From 12. water reactor safety research information meeting; Gaithersburg, MD, USA (23 Oct 1984).

The Cylindrical Core Test Facility (CCTF) and the Slab Core Test Facility (SCTF) are the facilities of the Large Scale Reflood Test Program which was initiated in April, 1976. This program has been built in the 2D/3D project which is performed by USNRC, BMFT and JAERI. The CCTF is designed to model a four-loop 1000MWe PWR with the flow area scaling ratio of 1/21.44 and has a scaled pressure vessel with a full length core and four loops with passive and active components. Using CCTF, the core thermo-hydrodynamic behavior coupled with the system behavior in the primary loops has been investigated for the refill and reflood phases of a PWR-LOCA. The SCTF is being operated to complement the results from CCTF specially in the field of the multi-dimensional thermo-hydrodynamic behavior in a radially wide core and upper plenum. The SCTF has a full length, full radius and one-bundle depth PWR simulated core which is composed of in-line eight bundles, and has downcomer, upper plenum, lower plenum and simplified loop with passive components. In this presentation, the following topics are explained: 1) CCTF best estimate (BE) test; 2) CCTF refill test; 3) CCTF multi-dimensional test; 4) SCTF multi-dimensional test; and 5) related code development.

30980 (NUREG/CP—0058-Vol.2, pp 373-394) **TRAC analyses for CCTF and SCTF tests and UPTF design/operation.** Motley, F.E. (Los Alamos National Lab., NM). Jan 1985. NTIS, PC A20/MF A01 - GPO $9.00. File Number TI85900642. (CONF-8410142—Vol.2).

From 12. water reactor safety research information meeting; Gaithersburg, MD, USA (23 Oct 1984).

The 2D/3D Program is a multinational (Germany, Japan, and the US) experimental and analytical nuclear reactor safety research program. Its main purpose is the investigation of multidimensional thermal-hydraulic behavior in large-scale experimental test facilities having hardware prototypical of pressurized water reactors (PWRs). The Japanese are presently operating two large-scale test facilities as part of this program: the Cylindrical Core Test Facility (CCTF) and the Slab Core Test Facility (SCTF). The German contribution to the program is the Upper Plenum Test Facility (UPTF), a full-scale facility with vessel, four loops, and a steam-water core simulator under construction in Mannheim, Germany. The US contributions to the program are the provision of advanced two-phase flow instrumentation and analytical support. The Los Alamos National Laboratory is the prime contractor to the US NRC in the latter activity. The main analytical tool in this program is in the Transient Reactor Analysis Code (TRAC), a best-estimate, multidimensional, nonequilibrium, thermal-hydraulics computer code developed for the US NRC at Los Alamos. Through code predictions of experimental results and calculations of PWR transients, TRAC provides the analytical coupling between the facilities and extends the results to predicting actual PWR behavior. Activities during fiscal 1984 are discussed.

30981 (NUREG/CP—0058-Vol.2, pp 395-408) **Safety analysis code input automation using the Nuclear Plant Data Bank.** Kopp, H.; Leung, J.; Tajbakhsh, A.; Viles, F. Jan 1985. NTIS, PC A20/MF A01 - GPO $9.00. File Number TI85900642. (CONF-8410142—Vol.2).

From 12. water reactor safety research information meeting; Gaithersburg, MD, USA (23 Oct 1984).

The Nuclear Plant Data Bank (NPDB) is a computer-based system that organizes a nuclear power plant's technical data, providing mechanisms for data storage, retrieval, and computer-aided engineering analysis. It has the specific objective to describe thermohydraulic systems in order to support: rapid information retrieval and display, and thermohydraulic analysis modeling. The Nuclear Plant Data Bank (NPBD) system fully automates the storage and analysis based on this data. The system combines the benefits of a structured data base system and computer-aided modeling with links to large scale codes for engineering analysis. Emphasis on a friendly and very graphically oriented user interface facilitates both initial use and longer term efficiency. Specific features are: organization and storage of thermohydraulic data items, ease in locating specific data items, graphical and tabular display capabilities, interactive model construction, organization and display of model input parameters, input deck construction for TRAC and RELAP analysis programs, and traceability of plant data, user model assumptions, and codes used in the input deck construction process. The major accomplishments of this past year were the development of a RELAP model generation capability and the development of a CRAY version of the code.

30982 (NUREG/CP—0058-Vol.3, pp 19-39) **Analysis of small-small-break LOCA sequences in the Oconee-1 power plant.** Dearing, J.F. (Los Alamos National Lab., NM). Jan 1985. NTIS, PC A99/MF A01 - GPO $12.00. File Number TI85901093. (CONF-8410142—Vol.3).

From 12. water reactor safety research information meeting; Gaithersburg, MD, USA (23 Oct 1984).

This paper presents an analysis of a particular accident sequence in the Oconee-1 power plant. The initiator for this sequence is a random break of less than 102-mm (4-in.) diameter in the primary-system cold-leg piping. During the course of the accident, the high-pressure recirculation system is assumed to not be functional and the steam generators to remain isolated. The supply of once-through borated water will allow the high pressure injection system (HPIS) system to function while the operator attempts to either restore high-pressure recirculation or bring the primary to conditions under which the low-pressure recirculation system is functional. The response of the primary system is strongly determined by both break size and HPIS flow. For small breaks it may be necessary to limit the amount of HPIS flow to depressurize the primary. This strategy will extend the life of the once-through cooling water, but will also decrease the cooling rate of the primary system. Calculations were performed to indicate the effect of varying break size and operator throttling of the HPIS on several important factors that will help determine the outcome of the accident. These include 1) effectiveness of the HPIS in keeping the primary full, 2) ability to reach conditions of low-pressure recirculation, and 3) time duration that once-through cooling water remains available. The analysis was performed using TRAC/PF1.

30983 (NUREG/CP—0058-Vol.3, pp 40-46) **Integrated TRAC/MIMAS analysis of core damage from a TMLB′ sequence in Oconee-1.** Henninger, R.J.; Smith, R.C.; Boyack, B.E. (Los Alamos National Lab., NM). Jan 1985. NTIS, PC A99/MF A01 - GPO $12.00. File Number TI85901093. (CONF-8410142—Vol.3).

From 12. water reactor safety research information meeting; Gaithersburg, MD, USA (23 Oct 1984).

Realistic estimates of radioactive releases in the event of a severe accident require the use of a mechanistic calculational tool that models the entire primary system of a pressurized water reactor (PWR). This tool must begin with an accident initiator and determine the entire accident sequence up to failure of and release of radioactivity from the primary system. The TRAC/MELPROG code under joint development by Sandia and Los Alamos National Laboratories will provide such a capability. The models in the TRAC/MELPROG code will be sufficiently detailed to provide insights into the effects of all the important phenomena occurring in a degraded-core accident including multi-dimensional flow within the reactor vessel. An important step in the development of TRAC/MELPROG is TRAC/MIMAS. Although it is limited by one-dimensional fluids modeling, lack of a debris bed model and one-dimensional modeling of important vessel structures, TRAC/MIMAS provides useful information about a degraded-core accident up to debris bed formation. In this presentation, the authors analyze a sample calculation of a loss of feedwater with failure of the emergency core cooling system (TMLB′) sequence for Oconee-1.

30984 (NUREG/CP—0058-Vol.3, pp 109-121) **Chemical factors affecting fission product transport in BWR severe accidents.** Beahm, E.C.; Wichner, R.P.; Weber, C.F. (Oak Ridge National Lab., TN). Jan 1985. NTIS, PC A99/MF A01 - GPO $12.00. File Number TI85901093. (CONF-8410142—Vol.3).

From 12. water reactor safety research information meeting; Gaithersburg, MD, USA (23 Oct 1984).

Chemical changes may significantly alter physical properties of fission product materials, and hence their state and transport rate. Thus, it is possible that an appropriate accounting of chemical change could have a large impact on transport model results. This paper will describe how the chemical reactions of Cs, I, and Te are being implemented in the transport model that is used in the Severe Accident Sequence Analysis (SASA) Program at Oak Ridge National Laboratory (ORNL).

30985 (NUREG/CP—0058-Vol.3, pp 122-135) **Fission product transport analysis in a loss of decay heat removal accident at Browns Ferry.** Wichner, R.P.; Weber, C.F.; Hodge, S.A. (Oak Ridge National Lab., TN). Jan 1985. NTIS, PC A99/MF A01 - GPO $12.00. File Number TI85901093. (CONF-8410142—Vol.3).

From 12. water reactor safety research information meeting; Gaithersburg, MD, USA (23 Oct 1984).

This paper summarizes an analysis of the movement of noble gases, iodine, and cesium fission products within the Mark-I containment BWR reactor system represented by Browns Ferry Unit 1 during a postulated accident sequence initiated by a loss of decay heat removal (DHR) capability following a scram. The event analysis showed that this accident could be brought under control by various means, but the sequence with no operator action ultimately leads to containment (drywell) failure followed by loss of water from the reactor vessel, core degradation due to overheating, and reactor vessel failure with attendant movement of core debris onto the drywell floor. The analysis of fission product transport presented in this paper is based on the no-operator-action sequence and provides an estimate of fission product inventories as a function of time within 17 control volumes outside the core, with the atmosphere considered as the final control volume in the transport sequence. The paper includes discussion of fission product transport calculation features, control volumes, loss of decay heat removal accident sequence, and results, i.e., predicted radioactive inventories in major reactor zones.

30986 (NUREG/CP—0058-Vol.3, pp 217-233) **Preliminary results of the KFK molten core/concrete experimental β facility.** Alsmeyer, H.; Reimann, M.; Hosemann, J.P. (Kernforschungszentrum Karlsruhe, West Germany). Jan 1985. NTIS, PC A99/MF A01 - GPO $12.00. File Number TI85901093. (CONF-8410142—Vol.3).

From 12. water reactor safety research information meeting; Gaithersburg, MD, USA (23 Oct 1984).

The investigations discussed in this paper are part of the core meltdown accident research in the Federal Republic of Germany (FRG) which concentrates on risk assessment and is not regarded as a basis for licensing procedures. First, a brief summary of the FRG view on severe pressurized water reactor accidents is given. The special objectives of the melt/concrete investigations in light of source term evaluation, a description of the β test facility, experimental results, and a comparison of the results with the WECHSL code are discussed, and conclusions are presented.

30987 (NUREG/CP—0058-Vol.3, pp 290-301) **Mechanisms in dryout of debris beds.** Theofanous, T.G.; Hu, K. (Purdue Univ., Lafayette, IN). Jan 1985. NTIS, PC A99/MF A01 - GPO $12.00. File Number TI85901093. (CONF-8410142—Vol.3).

From 12. water reactor safety research information meeting; Gaithersburg, MD, USA (23 Oct 1984).

Experimental results from Purdue's Large Scale Debris Bed Coolability Facility have identified an important aspect of the dryout behavior that not only provides definitive direction concerning the controlling mechanism but have also provided the means for precise definition and measurement of Dryout Inception Power (DIP). The first data on transient development of dryout for powers exceeding the DIP are also presented. By taking into account the power-to-dryout time delay an unambiguous definition of dryout inception was developed which together with a well instrumented bed provided highly reproducible dryout inception data. These data are unique in bed dimensions (near full scale) and particulate characteristics (non-spherical particles). Based on the data, the Theofanous-Saito correlation is recommended for use in LWR severe accident assessments.

30988 (NUREG/CP—0058-Vol.3, pp 323-337) **Steam explosion studies at Winfrith.** Briggs, A.J. (United Kingdom Atomic Energy Authority, Winfrith, England). Jan 1985. NTIS, PC A99/MF A01 - GPO $12.00. File Number TI85901093. (CONF-8410142—Vol.3).

From 12. water reactor safety research information meeting; Gaithersburg, MD, USA (23 Oct 1984).

Studies of molten fuel-coolant interaction, (MFCI), were started at the Winfrith establishment of the UKAEA in 1975 and have continued since that time. Early in the program the main interest was in fast reactor applications, but more recently much of the work has been concerned with PWR applications, because of the proposal to build a PWR in the UK at Sizewell. This program has concentrated on experimental work which has had three overlapping stages. Stage 1 used simulant materials to observe the characteristics of an explosion in a system large enough for propagation to be important. Stage 2 used thermite-generated molten UO_2 to study the interaction of small masses of higher temperature melt with water and sodium. Stage 3 is investigating the interaction of larger masses of high temperature melt in situations more closely related to reactor accident conditions. Stage 3 of the program is discussed in the paper. Within the overall aim of improving understanding of MFCI phenomena three topics are included in the Winfrith program which particularly relate to the uncertainty of a large in-vessel steam explosion leading to early containment failure: 1) scaling; 2) mixing limitations; and 3) trigger phenomena. These topics and some basic studies being conducted are discussed.

30989 (NUREG/CP—0058-Vol.3, pp 401-422) **BNL severe accident sequence experiments and analysis program.** Greene, G.A.; Ginsberg, T.; Tutu, N.K. (Brookhaven National Lab., Upton, NY). Jan 1985. NTIS, PC A99/MF A01 - GPO $12.00. File Number TI85901093. (CONF-8410142—Vol.3).

From 12. water reactor safety research information meeting; Gaithersburg, MD, USA (23 Oct 1984).

Analyses of LWR degraded core accidents require mathematical characterization of two major sources of pressure and temperature loading on the reactor containment buildings: (1) steam generation from core debris-water thermal interactions and (2) molten core-concrete interactions. Experiments are in progress at BNL in support of analytical model development related to aspects of the above containment loading mechanisms. The work supports development and evaluation of the CORCON, MARCH, CONTAIN and MEDICI computer under development at other NRC-contractor laboratories. The thermal-hydraulic behavior of hot debris located within the reactor core region upon sudden introduction of cooling water is being investigated in a joint experimental and analytical program. This work supports development and evaluation of the SCDAP computer code being developed at EG and G to characterize in-vessel severe core damage accident sequences. Progress is described in the two areas of: 1) core debris thermal-hydraulic phenomenology and 2) heat transfer in core-concrete interactions.

30990 (NUREG/CP—0058-Vol.3, pp 445-459) **COBRA-NC application to containment analysis.** Wheeler, C.L.; Thurgood, M.J. (Battelle, Pacific Northwest Lab., Richland, WA). Jan 1985. NTIS, PC A99/MF A01 - GPO $12.00. File Number TI85901093. (CONF-8410142—Vol.3).

From 12. water reactor safety research information meeting; Gaithersburg, MD, USA (23 Oct 1984).

The COBRA-NC (Nuclear Containment) computer code has been developed for the US NRC at the Battelle-operated Pacific Northwest Laboratory to analyze thermal-hydraulic transients in light water reactor containment buildings. It is designed to predict room pressurization, pressure differentials between rooms, jet impingement forces, and asymmetric loads during a loss-of-coolant accident. It is also designed to predict the distribution of hydrogen and noncondensable gases within the containment building, both during and following a loss-of-coolant accident where hydrogen may be generated by metal-water reactions or by radiolysis. Code improvements and applications are discussed in this paper.

30991 (NUREG/CP—0058-Vol.3, pp 460-480) **Statistical evaluation of the heat transfer data obtained in the HDR containment tests.** Almenas, K.; Lee, U.C. (Univ. of Maryland, College Park). Jan 1985. NTIS, PC A99/MF A01 - GPO $12.00. File Number TI85901093. (CONF-8410142—Vol.3).

From 12. water reactor safety research information meeting; Gaithersburg, MD, USA (23 Oct 1984).

The containment tests conducted at the HDR facility have greatly expanded the experimental data base for energy transfer in large, complex geometry volumes. This data has been made available in a sequence of experimental reports, and its affect on heat-transfer modeling has been analyzed in several studies. Two categories of energy transfer data are provided by the experiments: 1) Integral energy transfer rate, either overall or compartment dependent, has to be inferred from appropriate energy balances utilizing experimental pressure, temperature and blow down rate measurements; 2) Local energy transfer rate is measured directly at up to 12 locations within the containment. The HDR heat-transfer measurements have become the fundamental data-base for benchmarking containment heat transfer modeling. The approaches taken in the modeling are discussed in detail.

30992 (NUREG/CP—0058-Vol.3, pp 512-535) **FRAPCON-2 assessment: power reactor fuel performance data and code evaluation status.** Coleman, D.R. Jan 1985. NTIS, PC A99/MF A01 - GPO $12.00. File Number TI85901093. (CONF-8410142—Vol.3).

From 12. water reactor safety research information meeting; Gaithersburg, MD, USA (23 Oct 1984).

The Nuclear Regulatory Commission's Division of Accident Evaluation (DAE) is sponsoring a fuel behavior research program entitled "Evaluation of Power Reactor Fuel Performance Analysis Capabilities". The main program objective is to evaluate the performance and accuracy of DAE-sponsored fuel rod material behavior codes for application to commercial fuel design and operational conditions. Program emphasis to data has been on the steady state fuel rod model, FRAPCON-2. During each of 2 FRAPCON activity phases, available high burnup results from EPRI and DOE sponsored power reactor fuel surveillance programs have been acquired, reviewed, and analyzed to provide the basic code input and fuel performance data. This data is then applied to the generation of FRAPCON predictions, the systematic comparison of key predicted and measured fuel performance parameters, and the interpretation of results to identify code capabilities and outstanding model development requirements. The program activities are documented in the form of Data and Code Evaluation Reports.

30993 (NUREG/CP—0058-Vol.3, pp 536-556) **Degraded core analysis.** Gittus, J.H. (United Kingdom Atomic Energy Authority). Jan 1985. NTIS, PC A99/MF A01 - GPO $12.00. File Number TI85901093. (CONF-8410142—Vol.3).

From 12. water reactor safety research information meeting; Gaithersburg, MD, USA (23 Oct 1984).

An analysis of the likelihood and the consequences of degraded core accidents has been undertaken for the proposed Sizewell B PWR, by the UK Atomic Energy Authority, the Industry, and the National Radiological Protection Board. This analysis, results of which are summarized in the present paper, discloses an encouraging situation revealing that the risks posed by the plant to the public have been held to very low levels.

30994 (NUREG/CP—0058-Vol.3, pp 557-566) **EPRI core materials program.** Franklin, D.; Gehl, S.; Machiels, A.; Santucci, J. (Electric Power Research Institute, Palo Alto, CA). Jan 1985. NTIS, PC A99/MF A01 - GPO $12.00. File Number TI85901093. (CONF-8410142—Vol.3).

From 12. water reactor safety research information meeting; Gaithersburg, MD, USA (23 Oct 1984).

The EPRI Core Materials program investigates the behavior of materials whose properties are significantly influenced by the irradiation field of the core. The components of current primary interest are fuel rods and assemblies, control materials, BWR stainless steel structural core components, and BWR fuel channels. The primary emphasis is on reliability. The secondary emphasis is on extending the service life of periodically replaced components. The following discussion is limited to research on fuel performance. The primary issues are fuel reliability, waterside corrosion, Zircaloy hydriding and corrosion, fission-product release, and deformation. The paper begins with a presentation of the EPRI goals. This is followed by a discussion of the primary technical issues associated with fuel performance and the improved designs being pursued.

30995 (NUREG/CP—0058-Vol.3, pp 567-573) **US Department of Energy extended burnup program.** Lang, P.M. (Dept. of Energy, Washington, DC). Jan 1985. NTIS, PC A99/MF A01 - GPO $12.00. File Number TI85901093. (CONF-8410142—Vol.3).

From 12. water reactor safety research information meeting; Gaithersburg, MD, USA (23 Oct 1984).

For several years the Department of Energy and other organizations have been supporting projects to extend the burnup of nuclear fuel in light water reactors. This paper reviews the Department's research and development projects under which a large number of test assemblies are being irradiated in power reactors and under which experiments and studies on individual technical issues, such as fission-gas release, are being conducted. The principal motivations for extended burnup are improved fuel performance and economics and reduced spent fuel generation, rather than safety. Nevertheless, safety related work has been included as an integral part of extended burnup development, since licensing of burnup extension is a necessary part of its implementation. In addition, burnup extension yields safety and environmental advantages: improved fuel integrity, reduced occupational radiation exposures, reduced fast neutron flux to the reactor vessel, and reduced generation of the spent fuel waste. This paper reviews the status of extended burnup research and development, highlighting the safety related work, and concludes with a discussion of the implementation of program results in commercial reactors.

30996 (NUREG/CP—0058-Vol.3, pp 574-583) **Radionuclide release to the environment under specific LWR accident conditins.** Gieseke, J.A.; Cybulskis, P.; Denning, R.S.; Kuhlman, M.R.; Lee, K.W. (Battelle Columbus Labs., OH). Jan 1985. NTIS, PC A99/MF A01 - GPO $12.00. File Number TI85901093. (CONF-8410142—Vol.3).

From 12. water reactor safety research information meeting; Gaithersburg, MD, USA (23 Oct 1984).

Analyses were performed to obtain more realistic estimates of the release of radionuclides to the environment in severe accidents. Results are presented for a variety of accident sequences in five different LWR plant designs. The predicted environmental release fractions obtained in these analyses are in most cases significantly lower than those in the WASH-1400 study. The methodology developed for this study is expected to form the technical basis for upgrading the methods used to analyze source terms in regulatory practice.

30997 (NUREG/CP—0058-Vol.3, pp 584-594) **Perspectives on technical issues evolving from the source term reassessment.** Denning, R.S. (Battelle Columbus Labs., OH). Jan 1985. NTIS, PC A99/MF A01 - GPO $12.00. File Number TI85901093. (CONF-8410142—Vol.3).

From 12. water reactor safety research information meeting; Gaithersburg, MD, USA (23 Oct 1984).

In the Source Term Reassessment Study, analyses have been performed for sequences in six references plants. The number of sequences selected for analysis was limited to a few risk-dominant sequences, augmented by additional sequences that cover a range of severe accident conditions. The computer codes used in the study to predict the thermal-hydraulic behavior, release of fission products from the fuel, transport through the reactor coolant system, transport through the containment and release to the environment are identified. Although major improvements have been made in source term methodology since WASH-1400, a number of residual technical issues have been identified in the Source Term Reassessment Study which lead to substantial uncertainties in source term estimation. The purpose of this paper is to identify the more significant of these issues and to provide perspective on their potential impacts on source term estimates.

30998 (NUREG/CP—0058-Vol.3, pp 607-631) **BWR safety research in Japanese industry.** Omoto, A. (Tokyo Electric Power Company, Inc., Japan). Jan 1985. NTIS, PC A99/MF A01 - GPO $12.00. File Number TI85901093. (CONF-8410142—Vol.3).

From 12. water reactor safety research information meeting; Gaithersburg, MD, USA (23 Oct 1984).

The paper describes the events that led to the inception of the Japanese Joint Study research programs for light water reactors and outlines the focus and achievements in reliability and technical development. Safety-related research in the fields of loss of coolant accidents (LOCA), iodine behavior, containment integrity, siting evaluation, and transients and stability are discussed with emphasis on LOCA and ECCS research.

30999 (NUREG/CP—0058-Vol.3, pp 632-650) **LOCA/ECCS integral tests with Two Bundle Loop.** Murase, M.; Ikeda, T.; Naitoh, M. (Energy Research Lab., Hitachi, Japan). Jan 1985. NTIS, PC A99/MF A01 - GPO $12.00. File Number TI85901093. (CONF-8410142—Vol.3).

From 12. water reactor safety research information meeting; Gaithersburg, MD, USA (23 Oct 1984).

Simulation tests of a single-ended BWR recirculation line break have been conducted using the Two Bundle Loop (TBL) with two full-size, electrically heated bundles. In the tests, a single failure of the high pressure core spray system was assumed and the test parameter was the break size. The uncovery period and the peak cladding temperature of the heated rods showed maximum values in a small break test; the highest peak cladding temperature was 806°K. Heatup initiations of the rods were delayed in the high power bundle due to the parallel channel effect, in the case of a large break where a mixture level was formed in the lower plenum and liquid drainage was limited at the bundle entry orifices due to the counter-current flow limitation.

31000 (NUREG/CP—0058-Vol.3, pp 651-662) **TBL analysis by best estimate codes.** Matsumoto, T.; Naitoh, M.; Sugisaki, T. (Energy Research Lab., Hitachi, Japan). Jan 1985. NTIS, PC A99/MF A01 - GPO $12.00. File Number TI85901093. (CONF-8410142—Vol.3).

From 12. water reactor safety research information meeting; Gaithersburg, MD, USA (23 Oct 1984).

TRAC-BD1 (Version 12) is a three-dimensional thermal-hydraulic code for analyzing boiling water reactor (BWR) loss of coolant accidents (LOCAs). The code was developed by EG and G Idaho, Inc. and General Electric Co. (GE) under the sponsorship of the US Nuclear Regulatory Commission. SAFER, which was developed under the cooperative efforts of GE, Hitachi and Toshiba as a licensing code, is a one-dimensional thermal-hydraulic code for analyzing long term coolant inventory of the reactor system in BWR-LOCAs. Analyses for large and small break tests conducted with the Two-Bundle Loop (TBL) have been performed to assess the capabilities of these codes. The TBL was constructed to simulate thermal-hydraulic behaviors during LOCAs in a BWR/5 plant. It is the only integral test facility with two full size electrically heated bundles and consists of two full length jet pumps, vessel internals, two recirculation loops, two blowdown lines and emergency core cooling systems.

31001 (NUREG/CP—0058-Vol.3, pp 663-674) **TBL analysis by best estimate codes.** Aoki, H.; Itoya, S.; Abe, N.; Arai, K. (Toshiba Corp., Yokohama, Japan). Jan 1985. NTIS, PC A99/MF A01 - GPO $12.00. File Number TI85901093. (CONF-8410142—Vol.3).

From 12. water reactor safety research information meeting; Gaithersburg, MD, USA (23 Oct 1984).

SAFER and TRAC-BDI are advanced, realistic-estimate system computer codes for BWR loss-of coolant accident (LOCA) analysis. Analyses of the two bundle loop (TBL) small break loss-of-coolant accident test have been performed using these computer codes. The purpose of these analyses is to assess SAFER and TRAC-BDI for the TBL test results which include the characteristic phenomena due to two channels with full length. This paper describes comparisons between calculations and test data. From present analysis, it was found that both codes predicted overall data trend and key phenomena very well. Furthermore, it was confirmed that SAFER predicted the higher peak cladding temperature due to the conservative heat transfer model.

31002 (NUREG/CP—0058-Vol.3, pp 675-692) **BWR core cooling in refill/reflood phase.** Nagasaka, H.; Yamada, K.; Kuwako, A. (Toshiba Corp., Yokohama, Japan). Jan 1985. NTIS, PC A99/MF A01 - GPO $12.00. File Number TI85901093. (CONF-8410142—Vol.3).

From 12. water reactor safety research information meeting; Gaithersburg, MD, USA (23 Oct 1984).

Recent experimental studies investigating a hypothetical boiling water reactor loss of coolant accident (BWR LOCA) have shown that there is a large safety margin in the licensing evaluation code calculations. One of the main reasons is the core cooling model in the current evaluation code, in which the uncovered region of the reactor core is assumed to be cooled only by the rated core spray water. And another is counter current flow limiting (CCFL) phenomena at core inlet orifices, which is neglected in the evaluation model. In the real condition estimated by the integral tests, the lower part of the core is reflooded due to the core inlet CCFL before the lower plenum becomes refilled and the upper part is cooled not only by the spray water but also the lower plenum flashing steam. In addition, when two-phase pool is held up in the upper plenum due to upper tie-plate (UTP) CCFL, the droplets through UTP contribute to the core cooling. To evaluate the core cooling characteristics, the following tests have been performed: (1) steam cooling test; (2) core inlet orifice CCFL test; and (3) spray heat transfer test. This paper summarizes the main results of the tests.

31003 (NUREG/CP—0058-Vol.3, pp 693-705) **BWR upper plenum mixing test.** Miura, S.; Sugisaki, T.; Horiuchi, T. (Hitachi, Ltd., Japan). Jan 1985. NTIS, PC A99/MF A01 - GPO $12.00. File Number TI85901093. (CONF-8410142—Vol.3).

From 12. water reactor safety research information meeting; Gaithersburg, MD, USA (23 Oct 1984).

The function of ECCS has been verified by LOCA/ECCS integral test simulating the phenomenon in the reactor pressure vessel from the beginning of LOCA to core reflooding due to ECCS actuation. The test facility which simulates full scale upper core and upper plenum (UPSET: Upper Plenum Simulation Equipment) was developed referring to the BWR plant in order to grasp the thermal hydraulic behaviors in the upper plenum of core under the multi-channel condition same as actual plant. Using this facility, the test to confirm the behavior of spray water in steam atmosphere had been performed. As a result, it was verified that the rate of channel dropping water in peripheral area of core exceeds the limited value of CCFL because of the effect of subcool water from the core spray system, thus contributing to the early core reflooding. Also, it was observed that the spray water is not carried out of system by entrainment and flows in the channel and bypass, thus contributing to the reflooding. Considering the results of LOCA/ECCS integral test, the simulated test of spray water behavior inside the upper plenum from the beginning of LOCA to core reflooding was performed.

31004 (NUREG/CP—0058-Vol.3, pp 706-721) **18° sector system test (ESTA-II).** Nagasaka, H.; Katoh, M.; Yokobori, S. (Toshiba Corp., Kawasaki, Japan). Jan 1985. NTIS, PC A99/MF A01 - GPO $12.00. File Number TI85901093. (CONF-8410142—Vol.3).

From 12. water reactor safety research information meeting; Gaithersburg, MD, USA (23 Oct 1984).

Recent emergency core cooling system (ECCS) tests simulating the hypothetical loss of coolant accident (LOCA) of BWR, have clarified that counter current flow limiting (CCFL) and CCFL breakdown phenomena at upper tie-plate (UTP) and core inlet orifice (SEO) play an important role in BWR refill-reflood phase. The 18° sector test apparatus (ESTA) which mocks up a BWR plant with full height from the jet pump bottom to standpipe top tested the separate effects of CCFL and CCFL breakdown. Following these tests, the apparatus was modified for system interaction testing. The objectives of this system response test by ESTA-II are to assess the multi-channel effect associated with CCFL and CCFL breakdown phenomena at UTPs and SEOs and to evaluate the full-scale, multi-channel refill-reflood scenario. Final goals are to confirm the validity of more realistic evaluation model SAFER, which treats the thermal hydraulic behaviors basically as one dimensional. This paper also includes the analysis of water level transients of each region inside shroud by TRAC-BD1, to check the data of these system tests theoretically.

31005 **(NUREG/CR—2000-Vol.4-No.4) Licensee Event Report (LER) compilation for month of April 1985. Volume 4, No. 4.** (Oak Ridge National Lab., TN (USA)). May 1985. Contract AC05-84OR21400. 85p. (ORNL/NSIC—200-Vol.4-No.4). NTIS, PC A05/MF A01 - GPO. File Number TI85012784.

This monthly report contains Licensee Event Report (LER) operational information that was processed into the LER data file of the Nuclear Safety Information Center (NSIC) during April 1985. The LERs, from which this information is derived, are submitted to the Nuclear Regulatory Commission (NRC) by nuclear power plant licensees in accordance with federal regulations. The LER summaries in this report are arranged alphabetically by facility name and then chronologically by event date for each facility. Component, system, keyword, and component vendor indexes follow the summaries.

31006 **(NUREG/CR—2531-Rev.3) Introductory user's manual for the US Nuclear Regulatory Commission Reactor Safety Research Data Bank. Revision 3.** Hardy, H.A.; Laats, E.T. (EG and G Idaho, Inc., Idaho Falls (USA)). Mar 1985. Contract AC07-76ID01570. 94p. (EGG—2164-Rev.3). NTIS, PC A05/MF A01 - GPO. File Number TI85011271.

The United States Nuclear Regulatory Commission (USNRC) has established the NRC/Division of Accident Evaluation (DAE) Data Bank Program to collect, store, and make available data from the many domestic and foreign water reactor safety research programs. Local direction of the program is provided by EG and G Idaho, Inc., prime contractor for the Department of Energy (DOE) at the Idaho National Engineering Laboratory (INEL). The NRC/DAE Data Bank Program provides a central computer storage mechanism and access software for data to be used by code development and assessment groups in meeting the code correlation needs of the nuclear industry. The administrative portion of the program provides data entry, documentation, training, and advisory services to users and the USNRC. The NRC/DAE Data Bank and the capabilities of the data access software are described in this document.

31007 **(NUREG/CR—2718) Steam explosion experiments with single drops of iron oxide melted with a CO_2 laser. Part II. Parametric studies.** Nelson, L.S.; Duda, P.M. (Sandia National Labs., Albuquerque, NM (USA)). Apr 1985. Contract AC04-76DP00789. 146p. (SAND—82-1105). NTIS, PC A07/MF A01 - GPO. File Number TI85012600.

The steam explosion experiments performed with single drops of molten iron oxide melted with a CO_2 laser, described in Part I of this report, were extended here. The following major parameters were varied: ambient pressure, water temperature and subcooling, melt temperature,and melt composition. Also, a few scoping experiments were performed to explore the effects of changing the nature of the coolant, and the viscosity of the melt. As each of the four major parameters was varied, thresholds could be located beyond which explosions were suppressed. However, in general, the explosions could be reinitiated by increasing the magnitude of the triggering pulse. The effects of increasing the ambient pressure up to 1.12 MPa were faster and finer melt fragmentation, and faster and more complete transfer of heat from melt to water. Moreover, triggering became easier over the range of ambient pressure between about 0.15 MPa and approximately 0.7 MPa.

31008 **(NUREG/CR—3317) Technical bases and user's manual for the prototype of a Suppression Pool Aerosol Removal Code (SPARC).** Owczarski, P.C.; Schreck, R.I.; Postma, A.K. (Pacific Northwest Labs., Richland, WA (USA)). May 1985. Contract AC06-76RL01830. 65p. (PNL—4742). NTIS, PC A04/MF A01 - GPO. File Number TI85013318.

This code was written to calculate the capture of aerosol particles in the pressure suppression pool (wet well) of a boiling water reactor under hypothetical accident conditions. The code incorporates five aerosol scrubbing models and two thermal-hydraulic models. The scrubbing models describe (1) steam condensation, (2) soluble particle growth in a humid atmosphere, (3) gravitational settling, (4) inertial deposition, (5) diffusional deposition. Mechanical entrainment of pool liquid by breaking of bubbles at the surface was also considered. An optional model for equilibrium pool temperature and a model for steam evaporation are the two thermal-hydraulic models used in the code. Steam evaporation was found to significantly retard deposition processes in pools near the boiling point. The code user supplies the values of several controlling variables in the code input. The SPARC output can include the decontamination factors (DF) of twenty different particle size groups, an overall DF for the whole particle distribution, particle log normal distribution parameters, and mass flow rates of particles (wet and dry) leaving the pool.

31009 **(NUREG/CR—3551) Safety implications associated with in-plant pressurized gas storage and distribution systems in nuclear power plants.** Guymon, R.H.; Casto, W.R.; Compere, E.L. (Oak Ridge National Lab., TN (USA)). May 1985. Contract AC05-84OR21400. 78p. (ORNL/NOAC—214). NTIS, PC A05/MF A01 - GPO. File Number TI85012807.

Storage and handling of compressed gases at nuclear power plants were studied to identify any potential safety hazards. Gases investigated were air, acetylene, carbon dioxide, chlorine, Halon, hydrogen, nitrogen, oxygen, propane, and sulfur hexaflouride. Physical properties of the gases were reviewed as were applicable industrial codes and standards. Incidents involving pressurized gases in general industry and in the nuclear industry were studied. In this report general hazards such as missiles from ruptures, rocketing of cylinders, pipe whipping, asphyxiation, and toxicity are discussed. Even though some serious injuries and deaths over the years have occurred in industries handling and using pressurized gases, the industrial codes, standards, practices, and procedures are very comprehensive. The most important safety consideration in handling gases is the serious enforcement of these well-known and established methods. Recommendations are made concerning compressed gas cylinder missiles, hydrogen line ruptures or leaks, and identification of lines and equipment.

31010 **(NUREG/CR—3651) Assessment of the adequacy of ORNL instrumentation in reflood test facilities.** Hardy, J.E.; Herskovitz, M.B. (Oak Ridge National Lab., TN (USA)). Apr 1985. Contract AC05-84OR21400. 53p. (ORNL/TM—9067). NTIS, PC A04/MF A01 - GPO. File Number TI85010620.

Instrumentation for making two-phase measurements in experimental refill-reflood test facilities was developed through the Advanced Instrumentation for Reflood Studies (AIRS) program. These unique instrumentation systems were designed to survive the severe in-vessel environmental conditions that exist during a simulated pressurized water reactor loss-of-coolant accident (LOCA). The measurements include two-phase flow velocity, void fraction, and film thickness and velocity, and are required for better understanding of reactor behavior during LOCAs. The adequacy (survivability and data quality) of the instrumentation systems installed in four experimental reflood test facilities is assessed. Signal conditioning electronics and sensor thermocouples functioned extremely well. For the first time, two-phase flow measurements were made in-core during a simulated LOCA. Because of the harsh environment and geometrical constraints, some sensor failures were considered likely; the number actually failing in service was within expectations. An exception to this record occurred in the Slab Core Test Facility - Core 1. A chloride-ion stress corrosion problem destroyed signal cables at the vessel seal for most sensors. This problem was corrected by changing the sealant material at the vessel penetration in the subsequent facilities. Overall, the performance of the instrumentation was very satisfactory yielding valuable data during simulated LOCAs in refill-reflood test facilities.

31011 **(NUREG/CR—3810-Vol.4) Reactor safety research programs. Quarterly report, October-December 1984. Volume 4.** Edler, S.K. (ed.). (Pacific Northwest Labs., Richland, WA (USA)). May 1985. Contract AC06-76RL01830. 29p. (PNL—5106-4-Vol.4). NTIS, PC A03/MF A01 - GPO. File Number TI85012832.

Results from an instrumented fuel assembly irradiation program being performed at Halden, Norway, are reported. Accelerated pellet-cladding interaction modeling is being conducted to predict the probability of fuel rod failure under normal operating conditions. Experimental data and analytical models are being provided to aid in decision making regarding pipe-to-pipe impacts following postulated breaks in high-energy fluid system piping. Fuel assemblies and analytical support are being provided for experimental programs at the Power Burst Facility, Idaho National Engineering Laboratory, Idaho Falls, Idaho. High-temperature materials property tests are being conducted to provide data on severe core damage fuel behavior. Thermal-hydraulic computer programs are providing best-estimate analyses for a variety of safety issues in light-water reactors. 8 figs., 1 tab.

31012 **(NUREG/CR—3862) Development of transient initiating event frequencies for use in probabilistic risk assessments.** Mackowiak, D.P.; Gentillon, C.D.; Smith, K.L. (EG and G Idaho, Inc., Idaho Falls (USA)). May 1985. Contract AC07-76ID01570. 277p. (EGG—2323). NTIS, PC E14/MF A01 - GPO. File Number TI85013441.

Includes 2 sheets of 24x reduction microfiche.

Transient initiating event frequencies are an essential input to the analysis process of a nuclear power plant probabilistic risk assessment. These frequencies describe events causing or requiring scrams. This report documents an effort to validate and update from other sources a computer-based data file developed by the Electric Power Research Institute (EPRI) describing such events at 52 United States commercial nuclear power plants. Operating information from the United States Nuclear Regulatory Commission on 24 additional plants from their date of commercial operation has been combined with the EPRI data, and the entire data base has been updated to add 1980 through 1983 events for all 76 plants. The validity of the EPRI data and data analysis methodology and the adequacy of the EPRI transient categories are examined. New transient initiating event frequencies are derived from the expanded data base using the EPRI transient categories and data display methods. Upper bounds for these frequencies are also provided. Additional analyses explore changes in the dominant transients, changes in transient outage times and their impact on plant operation, and the effects of power level and scheduled scrams on transient event frequencies. A more rigorous data analysis methodology is developed to encourage further refinement of the transient initiating event frequencies derived herein. Updating the transient event data base resulted in ~2400 events being added to EPRI's ~3000-event data file. The resulting frequency estimates were in most cases lower than those reported by EPRI, but no significant order-of-magnitude changes were noted. The average number of transients per year for the combined data base is 8.5 for pressurized water reactors and 7.4 for boiling water reactors.

31013 **(NUREG/CR—3904) Comparison of uncertainty and sensitivity analysis techniques for computer models.** Iman, R.L.; Helton, J.C. (Sandia National Labs., Albuquerque, NM (USA)). Mar 1985. Contract AC04-76DP00789. 116p. (SAND—84-1461). NTIS, PC A06/MF A01 - GPO. File Number TI85013272.

p.
Uncertainty analysis and sensitivity analysis are important elements in the development and implementation of computer models for complex processes. Typically, there are many uncertainties associated with both the development and the application of such models. Understanding of these uncertainties and their causes is required to effectively interpret model behavior. Many different techniques have been proposed for performing uncertainty and sensitivity analyses. The objective of the present study is to compare several widely used techniques on three models having large uncertainties and varying degrees of complexity in order to highlight some of the problem areas that must be addressed in actual applications. The following approaches to uncertainty and sensitivity analysis are considered: (1) response surface methodology based on input determined from a fractional factorial design, (2) Latin hypercube sampling with and without regression analysis, and (3) differential analysis. These techniques are compared on the basis of (1) ease of implementation, (2) flexibility, (3) estimation of the cumulative distribution function of the output, and (4) adaptability to different methods of sensitivity analysis. With respect to these criteria, the technique using Latin hypercube sampling and regression analysis gives the best results overall. The models used in the comparisons are well documented, thus making it possible for researchers to make comparisons of other techniques with the results in this study.

31014 **(NUREG/CR—3977) RELAP5 thermal-hydraulic analyses of pressurized thermal shock sequences for the H.B. Robinson Unit 2 pressurized water reactor.** Fletcher, C.D.; Bolander, M.A.; Waterman, M.E.; Burtt, J.D.; Stitt, B.D.; Kullberg, C.M.; Davis, C.B.; Ogden, D.M. (EG and G Idaho, Inc., Idaho Falls (USA)). Apr 1985. Contract AC07-76ID01570. 233p. (EGG—2341). NTIS, PC A11/MF A01 - GPO. File Number TI85012870.

Thermal-hydraulic analyses of fourteen hypothetical pressurized thermal shock (PTS) scenarios for the H.B. Robinson, Unit 2 pressurized water reactor were performed using the RELAP5 computer code. The scenarios, which were developed at Oak Ridge National Laboratory (ORNL), contain significant conservatisms concerning equipment failures, operator actions, or both.

31015 **(NUREG/CR—3980-Vol.3) Light-water-reactor safety fuel systems research programs. Quarterly progress report, July-September 1984. Volume 3.** (Argonne National Lab., IL (USA)). Apr 1985. Contract W-31-109-ENG-38. 48p. (ANL—84-61-Vol.3). NTIS, PC A03/MF A01 - GPO. File Number TI85011200.

This progress report summarizes work performed by the Materials Science and Technology Division of Argonne National Laboratory during July, August, and September 1984 on water reactor safety problems related to fuel and cladding. The research and development areas covered are Transient Fuel Response and Fission Product Release and Clad Properties for Code Verification. 17 refs., 23 figs., 5 tabs.

31016 **(NUREG/CR—4044) TRAC-PF1 LOCA calculations using fine-node and coarse-node input models.** Dobranich, D.; Buxton, L.D.; Wong, C.N.C. (Sandia National Labs., Albuquerque, NM (USA)). May 1985. Contract AC04-76DP00789. 83p. (SAND—2305). NTIS, PC A05/MF A01 - GPO. File Number TI85013275.

TRAC-PF1 calculations of a 200% cold-leg break LOCA have been completed for a UHI (upper head injection accumulator) plant using both fine-node (with 776 mesh cells) and coarse-node (with 320 mesh cells) input models. This study was performed to determine the effect of noding on predicted results and on computer running time. It was found that the overall sequence of events and the important trends of the transient were predicted to be nearly the same with both the fine-node and coarse-node models. There were differences in the time-dependent behavior of the cold-leg accumulator injection, and the predicted PCT for the coarse-node calculation was about 75 K less than that for the fine-node calculation. The higher PCT of the fine-node calculation is attributed primarily to three-dimensional flow effects in the core. The complete (steady state plus transient) coarse-node calculation required 13.5 hours of CYBER 76 computer time compared to 68.3 hours for the fine node calculation, yielding an overall factor of five decrease in running time. Thus, we conclude that for any large break LOCA analyses in which only the overall trends are of concern, the loss of accuracy resulting from use of such a coarse-node model will normally be inconsequential compared to the savings in resources that are realized. However, if the objective of the analyses is the investigation of the effects of multi-dimensional flows on clad temperatures, then a detailed model is required.

31017 (NUREG/CR—4079) Analytic studies pertaining to steam generator tube rupture accidents. Kashiwa, B.A.; Mjolsness, R.C. (Los Alamos National Lab., NM (USA)). Mar 1985. Contract W-7405-ENG-36. 83p. (LA—10307-MS). NTIS, PC A05/MF A01 - GPO. File Number TI85010350.

A study of the thermal-hydraulic phenomena of possible steam generator tube rupture (SGTR) accidents leads to the conclusions that (1) flashing will not occur upstream of the tube rupture, so that the flow will be resistance limited rather than choked, (2) there is considerable potential for discharging the primary fluid in the form of micron-sized droplets, particularly when the fluid discharges into a vapor cavity surrounding the tube rupture, and (3) that the surrounding of the rupture site by water rather than vapor may be a means for preventing the formation of micron-sized droplets. The presence or absence of micron-sized droplets is considered to be a key issue for the damage assessment of SGTR accidents because they are currently throught to be the most likely route for radioactive iodine to be released to the atmosphere.

31018 (NUREG/CR—4093) Safety/safeguards interactions during safety-related emergencies at Nuclear Power Reactor Facilities. Moul, D.A.; Pilgrim, M.K.; Schweizer, R.L.; McEwen, J.E. Jr. (Brookhaven National Lab., Upton, NY (USA); Wackenhut Advanced Technologies Corp., Reston, VA (USA)). Mar 1985. Contract AC02-76CH00016. 228p. (BNL-NUREG—51848). NTIS, PC A11/MF A01 - GPO. File Number TI85012310.

This report contains an analysis of the safety/safeguards interactions that could occur during safety-related emergencies at licensed nuclear power reactors, and the extent to which these interactions are addressed in existing or proposed NRC guidance. The safety/safeguards interaction during a series of postulated emergencies was systematically examined to identify any potential performance deficiencies or conflicts between the Operations (safety) and Security (safeguards) organizations. This examination included the impacts of coordination with off-site emergency response personnel. Duties, responsibilities, optimal methods, and procedural actions inherent in these interactions were explored.

31019 (NUREG/CR—4105) Assessment of thermal gradient tube results from the HI series of fission product release tests. Norwood, K.S. (Oak Ridge National Lab., TN (USA)). Mar 1985. Contract AC05-84OR21400. 63p. (ORNL/TM—9506). NTIS, PC A04/MF A01. File Number TI85010347.

A thermal gradient tube was used to analyze fission product vapors released from fuel heated in the HI test series. Complete deposition profiles were obtained for Cs, I, Ag, and Sb. The cesium profiles were complex and probably were dominated by Cs-S-O compounds formed by release of sulfur from furnace ceramics. The iodine profiles were simple, indicating that more than 99.5% of the released iodine behaved as a single nonvolatile species, probably CsI. Mass transfer coefficients for this species onto platinum were estimated to be 1.9 to 5.8 cm/s. Silver was probably released in elemental form, condensed to an aerosol, and captured by filters. Antimony was released as the element and reacted rapidly with platinum (or gold) as it deposited. Antimony profiles were calculated a priori with some success. A method was developed for isolating tellurium from platinum and mixed fission products in a form suitable for neutron activation analysis. The platinum samples were completely dissolved in acid (HCl/HNO_3), and the tellurium was precipitated on selenium carrier by reduction. Finally, tellurium was loaded onto Dowex 1X-4 ion-exchange resin for activation and analysis. Tellurium recovery was ~ 88%, and the theoretical sensitivity was ~ 30 ng.

31020 (NUREG/CR—4106) Pressurized-thermal-shock test of 6-in.-thick pressure vessels. PTSE-1: investigation of warm prestressing and upper-shelf arrest. Bryan, R.H.; Bass, B.R.; Bolt, S.E.; Bryson, J.W.; Edmonds, D.P.; McCulloch, R.W.; Merkle, J.G.; Nanstad, R.K.; Robinson, G.C.; Thoms, K.R. (Oak Ridge National Lab., TN (USA)). Apr 1985. Contract AC05-84OR21400. 289p. (ORNL—6135). NTIS, PC A13/MF A01 - GPO. File Number TI85010580.

The first pressurized-thermal-shock test of a 148-mm-thick steel pressure vessel with a 1-m-long flaw was performed to investigate fracture behavior of a vessel under conditions relevant to a flawed nuclear reactor pressure vessel during an overcooling accident. The objectives were to observe crack arrest and stability on the ductile upper shelf and the effects of warm prestressing on crack initiation. Three coordinated pressure and thermal transients were imposed on the vessel, which was preheated to ~290°C. Two episodes of crack propagation and arrest occurred. The thermal transients were induced by coolant at -29 to 15°C. Pressure transients were as high as 94.4 MPa. The experimental objectives were attained. The inhibiting effects of warm prestressing were definitely demonstrated. Crack propagation was nearly pure cleavage. Fracture-mechanics analysis of brittle fracture based on small-specimen toughness measurements was reasonably accurate.

31021 (NUREG/CR—4140) Dominant accident sequences in Oconee-1 pressurized water reactor. Dearing, J.F.; Henninger, R.J.; Nassersharif, B. (Los Alamos National Lab., NM (USA)). Apr 1985. Contract W-7405-ENG-36. 108p. (LA—10351-MS). NTIS, PC A06/MF A01 - GPO. File Number TI85013270.

A set of dominant accident sequences in the Oconee-1 pressurized water reactor was selected using probabilistic risk analysis methods. Because some accident scenarios were similar, a subset of four accident sequences was selected to be analyzed with the Transient Reactor Analysis Code (TRAC) to further our insights into similar types of accidents. The sequences selected were loss-of-feedwater, small-small break loss-of-coolant, loss-of-feedwater-initiated transient without scram, and interfacing systems loss-of-coolant accidents. The normal plant response and the impact of equipment availability and potential operator actions were also examined. Strategies were developed for operator actions not covered in existing emergency operator guidelines and were tested using TRAC simulations to evaluate their effectiveness in preventing core uncovery and maintaining core cooling.

31022 (NUREG/CR—4168) GT2F: a computer code for estimating light water reactor fuel rod failures. Williford, R.E.; Lanning, D.D.; Beyer, C.E. (Pacific Northwest Labs., Richland, WA (USA)). May 1985. Contract AC06-76RL01830. 275p. (PNL—5354). NTIS, PC A12/MF A01 - GPO. File Number TI85012551.

This report describes the development, benchmarking and results of a computer code designed to permit comparison of BWR and PWR fuel rod failure behaviors during postulated reactor off-normal events such as control rod withdrawal errors. The code is called GT2F, and was developed from the GAPCON-THERMAL-2 code by the addition of new models for calculating transient temperatures, fission gas release, mechanical interaction between fuel and cladding, and Zircaloy cladding fracture behavior. Results indicate that for the conservatively severe overpower transient scenarios assumed, a full length commercial BWR fuel rod has a failure probability between 1% and 4.5% at 27 MWd/kgM when the transient begins from high operating power. A full-length commercial PWR fuel rod has a failure probability between 2% and 11% at 28 MWd/kgM when the transient begins from low power. Failure probabilities are substantially smaller at lower burnups and for less extreme transient conditions.

31023 (NUREG/CR—4177-Vol.1) Management of severe accidents. Perspectives on managing severe accidents in commercial nuclear power plants. Vol. 1. DiSalvo, R.; Leonard, M.; Manahan, M.; Wreathall, J. (Battelle Columbus Labs., OH (USA)). May 1985. 98p. (BMI—2123-Vol.1). NTIS, PC A05/MF A01 - GPO. File Number TI85901530.

Accident management is examined from several different perspectives. The emphasis is on the role of the operating crew and the technical support provided to them before, during, and after an accident. The relationship among accident management, risk management, and emergency management is examined. The roles played by industry, regulation, and research are reviewed. Finally, the results of viewing accident management from these various perspectives are reflected in the articulation of issues and some proposals for their resolution.

31024 (NUREG/CR—4177-Vol.2) **Management of severe accidents. Extending plant operating procedures into the severe accident regime. Vol. 2.** Wreathall, J.; Leonard, M.; DiSalvo, R. (Battelle Columbus Labs., OH (USA)). May 1985. 73p. (BMI—2123-Vol.2). NTIS, PC A04/MF A01 - GPO. File Number TI85901531.

This study examines the feasibility and value/impact of extending emergency operating procedures into the severe accident regime. It reviews the types of knowledge needed to develop such procedures and the applicability of existing regulatory review criteria. A method is developed and illustrated in two test cases. This study concludes that it is feasible to develop procedures for operators to mitigate the consequences of accident progressing past the onset of core damage. A preliminary value/impact assessment indicates a significant likelihood of there being an overall net positive benefit of developing mitigative procedures. A phased program has been proposed. First a pilot study should develop the application of the methods used in this feasibility study and provide more precise information for a detailed value-impact assessment. Based on the results of the pilot study, extension to a greater population of plants may be justified.

31025 (NUREG/CR—4196) **Overview of TRAC-BD1 (Version 12) assessment studies.** Kullberg, C.M. (EG and G Idaho, Inc., Idaho Falls (USA)). Apr 1985. Contract AC07-76ID01570. 51p. (EGG—2382). NTIS, PC E07/MF $6.75 - GPO. File Number TI85012991.

Includes 15 sheets of 24x reduction microfiche.

A series of simulations were performed to continue the advancement of Boiling Water Reactor (BWR) safety research, with the TRAC-BD1 (Version 12) computer code. The principal motivation for performing these simulations was to assess the code's capability to calculate Loss-of-Coolant Accident (LOCA) related phenomena. The results of a number of TRAC-BD1 (Version 12) simulations, which cover a broad range of conditions during different types of LOCA scenarios, are summarized in this document. Selected comparisons between calculated and measured results are presented. Conclusions derived from those comparisons are given.

31026 (NUREG/CR—4205) **TRAP-MELT2 user's manual.** Jordan, H.; Kuhlman, M.R. (Battelle Columbus Labs., OH (USA)). May 1985. 71p. (BMI—2124). NTIS, PC A04/MF A01 - GPO. File Number TI85901543.

In hypothetical severe accidents in light water reactors, radionuclides released from the melting core will undergo chemical and physical changes and will deposit on various surfaces as they are transported through the reactor coolant system (RCS) to the containment. It is of considerable interest to know what fraction of these released materials actually reaches the containment and is potentially available for leakage to the environment. The TRAP-MELT2 computer code contains radionuclide transport and deposition models that are consistent with the emerging state of knowledge regarding release of radionuclides from melting cores and thermal-hydraulic behavior of the RCS during hypothetical meltdown accidents. This model is a modification and further development of the previously published TRAP-LOCA code developed for analysis of fission product transport and deposition in a terminated loss-of-coolant accident and the TRAP-MELT code described in a previous manual.

31027 (NUREG/CR—4230) **Probability-based evaluation of selected fire protection features in nuclear power plants.** Azarm, M.A.; Boccio, J.L. (Brookhaven National Lab., Upton, NY (USA)). May 1985. Contract AC02-76CH00016. 91p. (BNL-NUREG—51878). NTIS, PC A05/MF A01 - GPO. File Number TI85013092.

A probabilistic approach for the evaluation of major fire protection measures in nuclear power plants is described. The methods developed are applied to two representative fire areas - one similar to a cable routing room and the other typical of a diesel generator room. The fire areas chosen for application, the fire scenarios described, and the various fire-damage states specified in the two illustrative examples are used to evaluate those fire-protection guidelines which deal with automatic/manual fire detection and suppression systems, rated barriers, divisional separation, drainage systems, dampers, and fire rating of electrical cables. Tabular results are presented, which reflect the relative merits of these systems/features in terms of conditional probabilities of achieving various room-damage states. The conclusions drawn and the lessons learned through the course of this study are discussed, and the areas that may need further investigation are identified.

31028 (NUREG/CR—4231) **Evaluation of available data for probabilistic risk assessments (PRA) of fire events at nuclear power plants.** Krasner, L.M.; Ganti, C.S.; Vincent, B.G.; Samanta, P.K.; Boccio, J.L. (Factory Mutual Research Corp., Norwood, MA (USA); Brookhaven National Lab., Upton, NY (USA)). May 1985. Contract AC02-76CH00016. 71p. (BNL-NUREG—51879). NTIS, PC A04/MF A01 - GPO. File Number TI85013093.

Several crucial parameters are needed in the assessment of fire risk in nuclear power plants. Among those that need to be developed from a data base are: (1) fire frequency, (2) fire detection time, and (3) fire suppression time. Currently, the data base for nuclear power plants is not large enough to develop these parameters, considering fuel location, fuel geometry, combustion properties, enclosure geometry, etc. This study attempts to augment the nuclear data base by investigating the usefulness of other nonnuclear data bases which contain fire incident loss experience of occupancy classes having somewhat similar physical features and fire protection engineering systems normally found in nuclear power plants. This study has found that indeed some useful information can be gleaned from nonnuclear sources; in particular, detection and suppression times. However, other fire-risk data needs such as fire frequency and fire size would require other forms of data searches and data analyses that at this stage can only be conceptualized.

31029 (NUREG/CR—4254) **Occupational dose reduction and ALARA at nuclear power plants: study on high-dose jobs, radwaste handling, and ALARA incentives.** Dionne, B.J.; Baum, J.W. (Brookhaven National Lab., Upton, NY (USA)). May 1985. Contract AC02-76CH00016. 102p. (BNL-NUREG—51888). NTIS, PC A06/MF A01 - GPO. File Number TI85013084.

This report provides the NRC and the nuclear industry with information and data which will be useful for occupational dose reduction at nuclear power plants. An examination of high-dose jobs, reliable equipment selection, radioactive waste handling improvements, and ALARA incentives at nuclear power plants has been performed. The information and data in this report are being provided to the nuclear power industry not only for purposes of occupational dose reduction at nuclear power plants but also to reduce the cost to generate electricity through cost savings associated with dose reduction. 15 refs., 6 figs., 10 tabs.

31030 (NUREG/CR—4262-Vol.1) **Effects of control system failures on transients and accidents at a General Electric boiling water reactor. Volume 1. Main report.** Bruske, S.J.; Baxter, D.E.; Ransom, C.B.; Stromberg, H.M.; Fineman, C.P.; Hanson, R.G. (EG and G Idaho, Inc., Idaho Falls (USA)). May 1985. Contract AC07-76ID01570. 84p. (EGG—2394-Vol.1). NTIS, PC A05/MF A01 - GPO. File Number TI85013358.

This report documents the evaluation of the effects of nonsafety grade control system failures on a typical boiling water reactor plant. The methods utilized in this evaluation include a system level failure modes and effects analysis, deterministic computer analysis, a review of 3 years of recorded plant occurrences, a probability analysis and a review of applicable NRC criteria pertaining to control systems. This study identified three system failures that could cause transients leading to a reactor vessel overfill and of these three failures, two could also lead to a reactor coolant cooldown of greater than 100°F per hour. This study concluded that the existing NRC criteria, concerning control systems, adequately address the potential problem areas that were identified during this evaluation. It was recommended that the consequences and risk associated with overfill and overcool transients be further investigated.

31031 **(NUREG/CR—4262-Vol.2) Effects of control system failures on transients and accidents at a General Electric boiling water reactor. Volume 2. Appendices.** Bruske, S.J.; Baxter, D.E.; Ransom, C.B.; Stromberg, H.M.; Fineman, C.P.; Hanson, R.G. (EG and G Idaho, Inc., Idaho Falls (USA)). May 1985. Contract AC07-76ID01570. 340p. (EGG—2394-Vol.2). NTIS, PC A15/MF A01 - GPO. File Number TI85013359.

The following appendices are included: Failure mode and effects analysis tables, Detailed BWR computer model description, Scenario computer analysis and effects, BWR failure data base search, and Significant transient excerpts.

31032 **(ORNL/TM—8842) Review of the status of validation of the computer codes used in the severe accident source term reassessment study (BMI-2104).** Kress, T.S. (comp.). (Oak Ridge National Lab., TN (USA)). Apr 1985. Contract AC05-84OR21400. 477p. NTIS, PC A21/MF A01 - GPO. File Number TI85010582.

The determination of severe accident source terms must, by necessity it seems, rely heavily on the use of complex computer codes. Source term acceptability, therefore, rests on the assessed validity of such codes. Consequently, one element of NRC's recent efforts to reassess LWR severe accident source terms is to provide a review of the status of validation of the computer codes used in the reassessment. The results of this review is the subject of this document. The separate review documents compiled in this report were used as a resource along with the results of the BMI-2104 study by BCL and the QUEST study by SNL to arrive at a more-or-less independent appraisal of the status of source term modeling at this time.

31033 **(PNL-SA—12829) ESF collection effectiveness, a study in fine particle dynamics.** Winegardner, W.K.; Owczarski, P.C. (Pacific Northwest Labs., Richland, WA (USA)). Apr 1985. Contract AC06-76RL01830. 17p. (CONF-850406—7). NTIS, PC A02/MF A01 - GPO. File Number TI85010966.

From International symposium and workshop on particulate and multi-phase processes and the 16th annual meeting of the Fine Particle Society; Miami Beach, FL, USA (22 Apr 1985).

The characterization and dynamic behavior of fine particles are the main subjects of an ongoing investigation of the particle collection effectiveness of the engineered safety feature (ESF) systems in nuclear power plants. This investigation is part of a larger study of the release of radionuclides to the environment from such plants during postulated accidents that are severe but extremely unlikely. The ESF systems are installed to prevent the occurrence of severe accidents or mitigate their consequences. Several of these engineered systems can serve as particle collection devices. This report focuses on the analytical models that were developed to predict particle behavior in two systems that were not specifically designed for particle retention: the ice compartments of ice condenser containment systems in Pressurized Water Reactors (PWRs) and the suppression pools of Boiling Water Reactors (BWRs). The following section summarizes the topics considered in the development of models and computer codes for estimating the particle retention effectiveness of these two ESF systems. After the summary this paper describes the two ESF systems in more detail and discusses the behavior of particles in both situations.

31034 **(SAND—84-2043C) Investigation of fuel and clad relocation during LMFBR initiation phase accidents: the STAR experiment program.** Wright, S.A.; Schumacher, G.; Henkel, P.R. (Sandia National Labs., Albuquerque, NM (USA); Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.)). 1985. Contract AC04-76DP00789. 10p. (CONF-850410—51). NTIS, PC A02/MF A01; 1 - GPO; GPO Dep. File Number TI85012354.

From ANS/ENS fast reactor safety meeting; Knoxville, TN, USA (21 Apr 1985).

The reactivity effects of fuel and clad motion during Unprotected Loss of Flow accidents (ULOFs) strongly influence the accident progression in LMFBRs. To study these phenomena, a series of in-pile experiments (the STAR experiments) are being performed in which clad motion and fuel dispersal are observed in small pin bundles with high-speed cinematography. The major parameters varied in the series are power level, fuel type (fresh versus preirradiated), and number of pins. Results of the first four experiments are presented in the report. The irradiated fuel tests show early fuel disruption caused by fission products followed by rapid fuel sweep out and axial clad relocation.

31035 **(SKBF-KBS-TR—79-21) Technology and cost for decommissioning Swedish nuclear power plants.** (Swedish Nuclear Fuel Supply Co., Stockholm. Div. KBS). Oct 1979. 184p. (In Swedish). NTIS (US Sales Only), PC A09/MF A01. File Number DE85701245.

Various estimates concerning the costs of decommissioning a redundant nuclear power reactor to the green fields state are given in the literature. The purpose of this study is to provide background material for the Swedish nuclear power utilities to estimate the costs and time required to dismantle an ASEA-ATOM Boiling Water Reactor. The units Oskarshamn II and Barsebeck 1, both with an installed capacity of approximately 600 MW, serve as reference plants. The time of operation before final shutdown is assumed to be 40 years. Dismantling operations are initiated one year after shutdown. When the dismantling of the plant is finished the site shall be released for unrestricted use. The costs for dismantling and subsequent final disposal of the radioactive waste are estimated to approximately 500 million Swedish crowns (approx. 115 MUS$) in terms of 1979 crowns. The sum includes 25 per cent contingency. The dismantling cost is equivalent to 10-15 per cent of the installation cost of a corresponding new nuclear power plant. The exact percentage is dependent on the interest rate used during the construction period. It is shown in the study that a total dismantling can be accomplished in less than five years. This report is a compilation of studies performed by ASEA-ATOM and VBB based on premises given by KBS. The reports from these studies are collected in appendices, where also a short technical description of one of the reference plants is given.

31036 **(SKI-B—6-83) Thermal fatigue cracking in T-fittings of feed water systems. Development of testing methods for the determination of the depth of cracks.** Oesterberg, J. (Swedish Nuclear Power Inspectorate, Stockholm; Swedish Plant Inspectorate, Stockholm). Mar 1983. 171p. (In English and Swedish). NTIS (US Sales Only), PC A08/MF A01. File Number DE85701242.

The existence of thermal fatigue cracks can be determined by ultrasonic methods. The depth of the cracks will be of importance for evaluation of the seriousness of the situation. Currently, no method is available for determining depth of cracks without cutting and grinding. Methods for gaining information of crack depth have been discussed with leading European materials testing institutes. More elaborate ultrasonic methods have been tested with negative results. On testing signals from crack corners flood possible signals from the crack tips. At present no reliable technique based on ultrasonics exist (in Europe, that will give information of crack depth.

31037 **(SKI-B—32-82) Project CSNI - CASP. Summarizing final report 1983-03-15.** Marklund, J.E. (Swedish Nuclear Power Inspectorate, Stockholm). Mar 1983. 22p. (In Swedish). (STUDSVIK-SD—83-11; STUDSVIK-NR—83-248). NTIS (US Sales Only), PC A02/MF A01. File Number DE85701240.

The report contains a brief summary of the results of the February 1982 meeting of the Containment Working Group within OECD-CSNI/NEA. It also contains a summary of a parameter study made with the Swedish computer program COPTA on the OECD-CSNI containment standard problem CASP2. The tasks of the Containment Working Group has later been transferred to a new larger group PWG2 Transients and Breaks. Among the containment issues treated in this last meeting were -standards prob-

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lems, and Benchmark problems, -State-of-the-art reports, -test sites and ongoing research, -The hydrogen question, including a large EC study.

31038 (PNL-tr—447) **Feasibility of dismantling the biological shield by the blast-hole technique. Final report.** Freund, H.U.; Schumann, S.; Bol, J.; Haas, W.; Kaul, J.; Nickel, N.; Witterhold, F.G.; Rossmann, K. (Pacific Northwest Labs., Richland, WA (USA); Battelle-Institut e.V., Frankfurt am Main (Germany, F.R.)). 7 May 1985. Contract AC06-76RL01830. Translation of BIeV-R-65.036-4, August 1983. 173p. NTIS (US Sales Only), PC A08/MF A01; 1; GPO Dep. File Number DE85012910.

In order to demolish a decommissioned nuclear power plant, the first step is necessarily dismantling of the activated and contaminated structures. A careful explosive dismantling technique is developed for separation of the radioactive inner part of the biological shield (steel-reinforced concrete) of light-water reactors, and the parameters which determine the effectiveness of the technique are examined. These parameters include those characteristics of the technique which depend on the blast-hole technique, as well as the side effects on the surroundings, particularly building shock load and release and containment of aerosols. It is concluded that stepwise separation of the radioactive concrete can be achieved in several large-area blasts in compliance with the safety regulations. In this process the radioactive concrete is ejected in the form of small-size rubble from the reinforcing framework, so that the reinforcing bars, which contain the major part of the radioactivity, can be conditioned separately.

31039 (LA-tr—85-26) **Transient three-phase three-component systems. Part 1. Formulation of the system of differential equations.** Kolev, N.I. (Los Alamos National Lab., NM (USA); Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Neutronenphysik und Reaktortechnik). 1985. Contract W-7405-ENG-36. Translation of KfK-3910. 64p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85013267.

On the basis of the laws of conservation, the non-conservative form of a system of 18 quasi-linear partial differential equations was developed to describe a three-phase, three-component flow. The flow was described with three fields of velocity. Each field of flow consists of one inert and one non-inert component. Full thermodynamic and mechanical non-equilibrium between the fields was modeled. The simplest possible concentrations and entropy equations were obtained, with no simplifying assumptions. Also obtained was the definition of the Mach number and of the critical mass velocity, and thus the local criticality condition.

31040 **Hydrogen combustion in nuclear plant accidents and associated containment loads.** Sherman, M.P. (Sandia National Labs., Albuquerque, NM (USA)). *Nuclear Engineering and Design;* **82**: No. 1, 13-24(Oct 1984). (CONF-830864—). Contract AC04-76DP00789.

From 4. international seminar on fluid/structure dynamics and containment of nuclear reactors; Chicago, IL, USA (29 Aug 1983).

The objective of this paper is to describe the reactor safety problems in severe accidents due to hydrogen combustion. The generation of hydrogen is discussed. The combustion of hydrogen is considered in terms of diffusion flames, deflagrations, flammability limits, incomplete combustion of very lean deflagrations, detonations and accelerated flames. An example of analyses of hydrogen combustion in a Mark III BWR is given. The example shows the strong dependence of the predicted peak pressure and number of burns on the assumptions of the analyses, the compartmentalization of the model and the inclusion of buoyancy-driven flows.

31041 **Transport and release of fission products during nuclear reactor accident.** Lee, K.W.; Kuhlman, M.R.; Gieseke, J.A. (Battelle Columbus Labs., OH (USA)). pp 441-444 of '84 Proceedings of Korea symposium on science and technology. Seoul, Republic of Korea; The Korean Federation of Scientific and Technological Societies (1984). (CONF-840765—).

From Korea international symposium on science and technology; Seoul, Korea (2 Jul 1984).

This study represents the identification and formulation of a systematic, mechanistic approach to estimating source terms and the implementation of this approach through calculations of fission products release to the environment for a large PWR reactor under a selected set of accident conditions. The development and improvement of calculational procedures is an evolutionary process and in the long term must be verified through experimental studies. It is anticipated that as additional information is obtained the accuracy of predictions can be improved and uncertainties reduced. Transport and deposition of radionuclides were found to be quite dependent on the accident sequences and the corresponding thremal hydraulic conditions. Reduced temperatures led to increased deposition of vapor species, and reduced flow rates to increased aerosol deposition. It is to be recognized that the estimates of release fractions are subject to uncertainties in the data and computer models employed in the calculations and are expected to have been influenced by assumptions regarding plant geometry, thermal hydraulics, deposition mechanisms, and sequence events. The effects of these assumptions will be investigated as this study continues.

25 ENERGY STORAGE

2502 Compressed Gas

31042 (TVA/PUB—84/21c, pp 1408-1417) **Compressed air energy storage at New York State hydropower sites.** Pakenas, L.J.; Driggs, C.L. (New York State Energy Research and Development Authority, Albany). 1983. NTIS, PC A20/MF A01. File Number DE84007687. (CONF-830939—Vol.3).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

The use of hydraulic air compressors and air expander turbines to generate electric power from low-head hydropower sites on rivers, streams, and other bodies of water is evaluated. The concept is referred to as Air Storage Hydro. The evaluation of this concept has concentrated on plant capacities in the range of 1 to 5 MW at sites in New York State offering 15 feet of head or less. The hydraulic air compressor (HAC) is a low technology device, involving construction of underground shafts in rock formations. The HAC produces compressed air using water flowing through a change in stream elevation. Air is entrained in a water flow (in the form of bubbles) and compressed in a falling column of water. The air is allowed to separate out in a stilling chamber, where it is collected and stored for use. Process water subsequently returns to the source stream at a lower elevation. Environmental, regulatory and land use restrictions do not appear to represent major obstacles. Water quality may actually be improved by a plant installation as water passing through an HAC becomes saturated with oxygen. Capital costs of the studied plant arrangements ranged from $900 to $1300 per kilowatt, assuming 15 feet of head and single 5 MW fuel-fired turbine set. The plant competes with combustion turbines, cycling oil-fired steam plants, pumped storage, and purchase power on a cost of production basis. The plant also competes with development of conventional run-of-river hydro at the same site. Selection of the development approach requires a comparison of return on investment.

2503 Pumped Hydro

REFER ALSO TO CITATION(S) 30127, 30130, 30170, 30263

31043 (TVA/PUB—84/21b, pp 665-673) **Construction and commissioning of Dinorwic pump storage scheme.** Burbridge, R.N.G.; Razzell, R.N. (Central Electricity Generating Board, Barnwood, England). 1983. NTIS, PC A99/MF A01. File Number DE84008049. (CONF-830939—Vol.2).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

The business background to the CEGB's decision to begin development of this six unit 1800MW underground power station in the slate mountains of North Wales is outlined. The plant design specification calls for a 300,000 pressure cycle fatigue life and operational flexibility including rapid loading from 0-1320MW in 10 sec-

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onds. The managerial control of commissioning activities and early operating problems are discussed.

31044 (TVA/PUB—84/21b, pp 832-840) **Technology in manufacturing and operation of hydraulic turbines.** Okada, M.; Senco, K.; Yokoyama, T. 1983. NTIS, PC A99/MF A01. File Number DE84008049. (CONF-830939—Vol.2).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

To take advantages of hydroelectric power, trends of hydraulic turbine technology is diverging to large capacity of a unit and to small-scaled low head plant. Under this circumstance, hydraulic performance is being improved by introducing computer-aided flow analysis and leakage water reduction. Reliability of mechanical parts is being secured by applying finite element method and field-measured information to static and dynamic strength of runner. For more economical pumped-storage plant, a double stage pump-turbine with regulatory guide vanes up to 1000m head has been developed and is being developed up to 1500m head. Important field data of transient draft-pressure drop after load rejection and of condenser operation are fed back to the planning and designing of more advanced pump-turbines.

31045 (TVA/PUB—84/21b, pp 851-860) **Putting Raccoon Mountain pumped-storage plant to work.** Adkins, F.E. (Tennessee Valley Authority, Chattanooga). 1983. NTIS, PC A99/MF A01. File Number DE84008049. (CONF-830939—Vol.2).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

The Raccoon Mountain plant is still a pumped-storage plant of significant dimension. So far as is known, the power capacity of the individual reversing units has not yet been exceeded in service elsewhere. The assimilation of the plant as a functioning unit of the TVA power system is described and the changes made and experiences gained in moving toward that end are discussed. A variety of delays has occurred. Many of these are traceable to random hydraulic forces generated during the operation of the pump-turbines. These appear to have been greater than anticipated. Cavitation erosion of the pump-turbine runners was another major problem. A variety of setbacks occurred in the generators including a major stator winding failure and a cracked shaft forging. The semiconductor start-stop converter-inverter for pump starting, etc., has worked very satisfactorily. Switchgear at generator terminal voltage appears to be overworked in terms of the frequency of its operation. In the main switchyard, exploding 161-kV current transformers were a problem; operation of the plant could have been limited by the late arrival of the 161/500-kV transformers. The in-plant control system, as designed, worked almost without fault; but developing experience showed that for safe operation the plant would need a greater degree of manned operation than had been planned. It was also found desirable to provide local supervision and a maintenance force dedicated solely to this plant. Operating experience, as it affects the power system, is discussed. In the conclusions efforts are made to identify areas where further evaluation might lead to improvements.

31046 (TVA/PUB—84/21b, pp 861-870) **Salina Pumped-Storage Project - design and operating history.** Holway, D.K.; Moody, J.R. Jr. (Benham-Blair-Holway and Spragins, Tulsa, OK). 1983. NTIS, PC A99/MF A01. File Number DE84008049. (CONF-830939—Vol.2).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

The design, operating history and economics of the Salina Pumped-Storage Project are described. This project is one of the nation's earliest reversible-unit hydroelectric power projects. The project is owned and operated by the State of Oklahoma, Grand River Dam Authority, and is located in northeastern Oklahoma. The four-phase project will ultimately include 12 units with a maximum production capability of 520 MW. Construction began in 1965, with the first phase (3 units) in July 1971. The third and fourth phases are pending. Since the first phase of the project began commercial operation in 1968, the project has experienced a successful operating record of 15 years with relatively minor operating problems.

31047 (TVA/PUB—84/21b, pp 871-880) **Ludington Pumped Storage - ten years later.** Seguin, R.L. 1983. NTIS, PC A99/MF A01. File Number DE84008049. (CONF-830939—Vol.2).

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

A summation of the design and operating problems that have occurred at the Ludington Pumped Storage Plant during the first ten years of operation is presented. The remedies to these problems are also discussed with a review of those involved.

2504 Capacitor Banks

REFER ALSO TO CITATION(S) 31188

2506 Thermal

REFER ALSO TO CITATION(S) 30350, 30351, 30559, 30560, 30561, 30564, 30580, 31258

31048 (DTH-LET-RE—84-1) **Seasonal thermal energy storage in district heating systems.** Boldt, J.; Qvale, B. (Danmarks Tekniske Hojskole, Lyngby. Lab. for Energiteknik). Sep 1984. 223p. NTIS (US Sales Only), PC A10/MF A01. File Number DE85750797.

The technical and economic aspects of incorporating large-scale seasonal thermal energy storage into existing or planned district heating systems have been studied with the help of mathematical systems simulation. Realistic systems (present and future) and components have been used. The aim has been to arrive at results that could be generalized. The study has been limited to seasonal storage with only one storage cycle per year. Seasonal heat storage has been examined in relation to two types of district heating systems: Systems with a major part of the heat generated by cogeneration plants, and systems, where the main part of the heat is delivered from low-temperature heat sources, such as industrial surplus heat. Finally, the use of seasonal heat stores in connection with long-distance heat transmission pipelines have been studied.

31049 (FRNC-TH—1612) **Study of phase transitions of macroscopic and dispersed salt hydrates. Application to low temperature heat storage.** Combes, B. (Pau Univ., 64 (France)). Jun 1982. 150p. (In French). NTIS (US Sales Only), PC A07. File Number DE85751346.

Phase transformations of materials with latent heat adapted to low temperature thermal storage is studied. Three salt hydrates: sodium sulfate, thiosulfate, acetate and a ternary mixture of water, sodium sulfate and sodium carbonate are examined. Volumes of few cubic centimeters or cubic millimeters are studied during heating and cooling cycles. Thermal performance of the ternary mixture is evaluated. Dispersions of salt hydrate systems are studied for long term heat storage and heat recovery by induced nucleation.

2508 Chemical

31050 (DGRST—80-7-0026) **Thermocompressor or heat pump using metal hydrides.** Blondeau, M.; Bonneton, M.; Jannot, M. (Delegation Generale a la Recherche Scientifique et Technique (DGRST), 75 - Paris (France)). Aug 1981. 154p. (In French). NTIS (US Sales Only), PC A08. File Number DE85751352.

Metallic hydrides present interesting prospects for use in hydrogen storage and in thermodynamic sorption-desorption cycle machines. First the state of art of work at national and international level are exposed. The technical study leads to the choice of an exchanger technology, and to the development of a model and a test bed which allows one to simulate the thermocompressor function. The tests produce information regarding the choice of parameters with a view to designing "three source" thermodynamic machines. The hybride $LaNi_5$ is chosen for the tests. Analysis of the results, evaluations of the performances anticipated of hybride based machines and orientations of further research are given.

31051 (NP—5770294) **Energy storage by means of chemical reactions.** Iyimen-Schwarz, Z. (Osnabrueck Univ. (Germany, F.R.). Fachbereich Biologie/Chemie). 1983. 151p. (In German). NTIS (US Sales Only), PC A08/MF A01. File Number DE85770294.

A number of hydrates, alcoholates and hydrogen carbonates were studied with a view to their suitability as thermochemical energy storage media in the low-temperature range. The following hydrates were investigated: potassium alum, magnesium chloride-6-hydrate, calcium chloride-2-hydrate, strontium chloride-6-hydrate, barium chloride-2-hydrate, and calcium chloride semihydrate. Other substances studied were alcoholates of MgCl and CaCl with methanol and ethanol. Sodium bicarbonate and potassium bicarbonate have high energy densities. However, the reaction between two gaseous components poses some problems. The author's experiments did not result in definite statements on the storage characteristics of the substances investigated. A more accurate assessment requires further studies of a large number of cycles and a further scale-up (e.g. up to 1 m^3).

2509 Batteries

REFER ALSO TO CITATION(S) 31188

31052 (AD-A—151975/0/XAB) **Calcium/thionyl chloride battery technology. Interim report, June 1983-May 1984.** Higgins, R.I.; Potts, I. (Eagle-Picher Industries, Inc., Joplin, MO (USA). Electronics Div.). Jan 1985. 51p. NTIS, PC A04/MF A01.

This program is structured to develop both active and reserve configuration calcium-thionyl chloride electrochemical cells. The active configuration has required extensive work toward the storability on the calcium anode in electrolyte solution. A variety of electrolyte salts have been screened in an effort to improve storage characteristics. The reserve configuration could lend itself to high-temperature operation since calcium has such a high melting point when compared to lithium. Emphasis has been on the development of a high-discharge-rate cathode structure.

31053 (ANL/OEPM—85-1) **Development of a supported liquid membrane as a nickel-zinc secondary battery separator.** Poa, D.S.; Miller, J.F.; Yao, N.P. (Argonne National Lab., IL (USA)). May 1985. Contract W-31-109-ENG-38. 36p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85012591.

A liquid tertiary amine complexing agent is dissolved in an organic solvent and absorbed into and held within the pores of a microporous polymeric film (Celanese Celgard 2400 polypropylene) by either capillary or surface force. Screening tests were performed to identify the optimum tertiary amine/organic solvent combinations, as well as the optimum concentration range of the amine solutions. The treatment of Celgard 2400 microporous film with certain tertiary amine/organic solvent solutions, such as triethylamine/xylene or tripropylamine/xylene, had no significant effect on either zinc penetration resistivity (ZPR) or electrolytic resistivity of the membrane. When the film was treated with tri-n-octylamine solutions of very high amine concentration (above 75 vol %), the potential difference between the zinc cathode and the $Ni(OH)_2$ counter electrode, as well as the electrolytic resistance of the membrane, increased sharply (from 300 to 700%). Among the tertiary amine solutions tested in this study, trihexylamine/xylene, tri-n-octylamine (10 to 30 vol %)/toluene, and tri-n-octylamine (10 to 30 vol %)/xylene appeared to be the most promising, especially the last one. The treatment of the Celgard 2400 film with that solution increased the zinc penetration resistivity of the membrane by as much as 400%. Furthermore, this solution treatment also improved the electrolytic conductivity of the Celgard 2400 film.

31054 (CONF-840677—Summs., pp 2-4) **Electrochemistry: today and tomorrow.** Landgrebe, A.R. (Dept. of Energy, Washington, DC). Jun 1984. NTIS, PC A11/MF A01. File Number DE84013679.

From 6. DOE battery and electrochemical contractors' conference; Washington, DC, USA (25 Jun 1984).

31055 (CONF-840677—Summs., pp 5-7) **Technology base research project.** McLarnon, F. (Lawrence Berkeley Lab., CA). Jun 1984. NTIS, PC A11/MF A01. File Number DE84013679.

From 6. DOE battery and electrochemical contractors' conference; Washington, DC, USA (25 Jun 1984).

31056 (CONF-840677—Summs., pp 64-67) **DOE multiyear planning.** Quinn, J.E. (Dept. of Energy, Washington, DC). Jun 1984. NTIS, PC A11/MF A01. File Number DE84013679.

From 6. DOE battery and electrochemical contractors' conference; Washington, DC, USA (25 Jun 1984).

31057 (CONF-840677—Summs., pp 82) **Development of an ECS technology transfer plan.** Scheithauer, R.; Duchi, M.; Huss, W. Jun 1984. NTIS, PC A11/MF A01. File Number DE84013679.

From 6. DOE battery and electrochemical contractors' conference; Washington, DC, USA (25 Jun 1984).

31058 (CONF-840677—Summs., pp 224) **Bibliography of convective transport correlations.** Yuh, C.Y.; Selman, J.R. (Illinois Institute of Technology, Chicago). Jun 1984. NTIS, PC A11/MF A01. File Number DE84013679.

From 6. DOE battery and electrochemical contractors' conference; Washington, DC, USA (25 Jun 1984).

31059 (CONF-840677—Summs., pp 225-227) **Continuous organic electrochemical synthesis.** Baizer, M.M.; Pintauro, P.N.; Park, K.; Gilbert, S.; Nobe, K. (Univ. of California, Los Angeles). Jun 1984. NTIS, PC A11/MF A01. File Number DE84013679.

From 6. DOE battery and electrochemical contractors' conference; Washington, DC, USA (25 Jun 1984).

31060 (CONF-840677—Summs., pp 14-16) **Sodium-sulfur battery development.** Harlow, R.A.; McClanahan, M.L.; Minck, R.W. (Ford Aerospace and Communications Corp., Newport Beach, CA). Jun 1984. NTIS, PC A11/MF A01. File Number DE84013679. Contract AM04-79CH10012.

From 6. DOE battery and electrochemical contractors' conference; Washington, DC, USA (25 Jun 1984).

31061 (CONF-840677—Summs., pp 76-78) **PNL's energy storage technology analysis and evaluation project activities.** Ashton, W.B.; Imhoff, C.H.; Triplett, M.B. (Battelle Pacific Northwest Lab., Richland, WA). Jun 1984. NTIS, PC A11/MF A01. File Number DE84013679.

From 6. DOE battery and electrochemical contractors' conference; Washington, DC, USA (25 Jun 1984).

31062 (CONF-840677—Summs., pp 84-89) **Recent progress on Exxon's zinc-bromine battery.** Bellows, R.J.; Einstein, H.; Grimes, P.; Kantner, E.; Newby, K.; Malachesky, P. (Exxon Research and Engineering Co., Linden, NJ). Jun 1984. NTIS, PC A11/MF A01. File Number DE84013679.

From 6. DOE battery and electrochemical contractors' conference; Washington, DC, USA (25 Jun 1984).

31063 (CONF-840677—Summs., pp 146-147) **Design and development of a sealed 100-Ah hydrogen-nickel oxide battery.** Dunlop, J.D.; Earl, M.W.; Beauchamp, R. (COMSAT Labs., Clarksburg, MD). Jun 1984. NTIS, PC A11/MF A01. File Number DE84013679.

From 6. DOE battery and electrochemical contractors' conference; Washington, DC, USA (25 Jun 1984).

31064 (CONF-840677—Summs., pp 8-11) **Exploratory development and testing program.** Clark, R.P. (Sandia National Labs., Albuquerque, NM). Jun 1984. NTIS, PC A11/MF A01. File Number DE84013679.

From 6. DOE battery and electrochemical contractors' conference; Washington, DC, USA (25 Jun 1984).

31065 (CONF-840677—Summs., pp 40-43) **Testing activities at the National Battery Test Laboratory.** Hornstra, F.; DeLuca, W.H.; Gay, E.C.; Yao, N.P. (Argonne National Lab., IL). Jun 1984. NTIS, PC A11/MF A01. File Number DE84013679.

From 6. DOE battery and electrochemical contractors' conference; Washington, DC, USA (25 Jun 1984).

31066 (CONF-840677—Summs., pp 44-46) **Performance and evaluation results.** Butler, P.C.; Bush, D.M.; Freese, J.M. (Sandia National Labs., Albuquerque, NM). Jun 1984. NTIS, PC A11/MF A01. File Number DE84013679.

From 6. DOE battery and electrochemical contractors' conference; Washington, DC, USA (25 Jun 1984).

31067 (CONF-840677—Summs., pp 47-52) **Energy storage and the best facility progress report.** Pivec, A.; Hyman, E.A. (Public Service Electric and Gas Co., Newark, NJ). Jun 1984. NTIS, PC A11/MF A01. File Number DE84013679.

From 6. DOE battery and electrochemical contractors' conference; Washington, DC, USA (25 Jun 1984).

31068 (CONF-840677—Summs., pp 90-94) **Development of alkaline zinc/ferricyanide battery.** Hollandsworth, R.P.; Zegarski, J.; Adams, G.B.; Littauer, E.L. (Lockheed Missiles and Space Co.). Jun 1984. NTIS, PC A11/MF A01. File Number DE84013679.

From 6. DOE battery and electrochemical contractors' conference; Washington, DC, USA (25 Jun 1984).

31069 (CONF-840677—Summs., pp 99-102) **Dendritic zinc deposition in flow batteries.** Hsie, W.C.; Selman, J.R. (Illinois Institute of Technology, Chicago). Jun 1984. NTIS, PC A11/MF A01. File Number DE84013679.

From 6. DOE battery and electrochemical contractors' conference; Washington, DC, USA (25 Jun 1984).

31070 (CONF-840677—Summs., pp 107-110) **Zinc electrode morphology in acid electrolytes.** McBreen, J.; Gannon, E. (Brookhaven National Lab., Upton, NY). Jun 1984. NTIS, PC A11/MF A01. File Number DE84013679. Contract AC02-76CH00016.

From 6. DOE battery and electrochemical contractors' conference; Washington, DC, USA (25 Jun 1984).

31071 (CONF-840677—Summs., pp 111-113) **Iron-chromium redox battery development.** Hagedorn, N.H. (National Aeronautics and Space Administration, Cleveland, OH). Jun 1984. NTIS, PC A11/MF A01. File Number DE84013679. Contract AI04-80AL12726.

From 6. DOE battery and electrochemical contractors' conference; Washington, DC, USA (25 Jun 1984).

31072 (CONF-840677—Summs., pp 125-128) **Electrochemistry of the iodide/tri-iodide/iodine redox system in propylene carbonate.** Hanson, K.; Tobias, C.W. (Lawrence Berkeley Lab., CA). Jun 1984. NTIS, PC A11/MF A01. File Number DE84013679.

From 6. DOE battery and electrochemical contractors' conference; Washington, DC, USA (25 Jun 1984).

31073 (CONF-840677—Summs., pp 129-133) **Surface layers for rechargeable lithium cells.** Muller, R.H.; Nazri, G. (Lawrence Berkeley Lab., CA). Jun 1984. NTIS, PC A11/MF A01. File Number DE84013679. Contract AC03-76SF00098.

From 6. DOE battery and electrochemical contractors' conference; Washington, DC, USA (25 Jun 1984).

31074 (CONF-840677—Summs., pp 17-19) **β alumina research.** Miller, G.R.; Gordon, R.S.; Conabee, E.E. (Ceramatec, Inc., Salt Lake City, UT). Jun 1984. NTIS, PC A11/MF A01. File Number DE84013679.

From 6. DOE battery and electrochemical contractors' conference; Washington, DC, USA (25 Jun 1984).

31075 (CONF-840677—Summs., pp 20-22) **β''-alumina research.** Grothaus, K.R.; Hellstrom, E.E. (Sandia National Labs., Albuquerque, NM). Jun 1984. NTIS, PC A11/MF A01. File Number DE84013679.

From 6. DOE battery and electrochemical contractors' conference; Washington, DC, USA (25 Jun 1984).

31076 (CONF-840677—Summs., pp 23-25) **Improved β''-Al_2O_3 electrolyte through transformation toughening.** Green, D.J.; Metcalf, M.G. (Rockwell International Science Center, Thousand Oaks, CA). Jun 1984. NTIS, PC A11/MF A01. File Number DE84013679.

From 6. DOE battery and electrochemical contractors' conference; Washington, DC, USA (25 Jun 1984).

31077 (CONF-840677—Summs., pp 26-28) **Glass electrolytes for sodium/sulfur cells.** Roche, M.F.; Kucera, G.H. (Argonne National Lab., IL). Jun 1984. NTIS, PC A11/MF A01. File Number DE84013679.

From 6. DOE battery and electrochemical contractors' conference; Washington, DC, USA (25 Jun 1984).

31078 (CONF-840677—Summs., pp 29-32) **Transport studies.** Newman, J. (Lawrence Berkeley Lab., CA). Jun 1984. NTIS, PC A11/MF A01. File Number DE84013679. Contract AC03-76SF00098.

From 6. DOE battery and electrochemical contractors' conference; Washington, DC, USA (25 Jun 1984).

31079 (CONF-840677—Summs., pp 33-34) **High energy cathodes and anodes for molten salt batteries.** Mamantov, G. (Univ. of Tennessee, Knoxville). Jun 1984. NTIS, PC A11/MF A01. File Number DE84013679.

From 6. DOE battery and electrochemical contractors' conference; Washington, DC, USA (25 Jun 1984).

31080 (CONF-840677—Summs., pp 35) **Electrical conduction and corrosion processes in fast ion conducting glasses.** Tuller, H.L.; Uhlmann, D.R. (Massachusetts Institute of Technology, Cambridge). Jun 1984. NTIS, PC A11/MF A01. File Number DE84013679. Contract AC03-76SF00098.

From 6. DOE battery and electrochemical contractors' conference; Washington, DC, USA (25 Jun 1984).

31081 (CONF-840677—Summs., pp 36-38) **Principles of superionic conduction.** Wuensch, B.J. (Massachusetts Institute of Technology, Cambridge). Jun 1984. NTIS, PC A11/MF A01. File Number DE84013679.

From 6. DOE battery and electrochemical contractors' conference; Washington, DC, USA (25 Jun 1984).

31082 (CONF-840677—Summs., pp 95-98) **Potential distributions and transients in particulate electrodes of possible use in energy storage.** Huh, T.; Evans, J.W. (Lawrence Berkeley Lab., CA). Jun 1984. NTIS, PC A11/MF A01. File Number DE84013679. Contract AC03-76SF00098.

From 6. DOE battery and electrochemical contractors' conference; Washington, DC, USA (25 Jun 1984).

31083 (CONF-840677—Summs., pp 103-106) **Characterization and development of stable membranes for the alkaline zinc/ferricyanide battery.** Arnold, C. Jr.; Assink, R.A. (Sandia National Labs., Albuquerque, NM). Jun 1984. NTIS, PC A11/MF A01. File Number DE84013679.

From 6. DOE battery and electrochemical contractors' conference; Washington, DC, USA (25 Jun 1984).

31084 (CONF-840677—Summs., pp 116-119) **Lithium-alloy/metal sulfide battery research.** Redey, L. (Argonne National Lab., IL). Jun 1984. NTIS, PC A11/MF A01. File Number DE84013679.

From 6. DOE battery and electrochemical contractors' conference; Washington, DC, USA (25 Jun 1984).

31085 (CONF-840677—Summs., pp 120) **New battery materials.** Huggins, R.A. (Stanford Univ., CA). Jun 1984. NTIS, PC A11/MF A01. File Number DE84013679.

From 6. DOE battery and electrochemical contractors' conference; Washington, DC, USA (25 Jun 1984).

31086 (CONF-840677—Summs., pp 121-124) **Polysulfide containment materials.** Brown, A.P.; Smaga, J.A.; Battles, J.E. (Argonne National Lab., IL). Jun 1984. NTIS, PC A11/MF A01. File Number DE84013679.

From 6. DOE battery and electrochemical contractors' conference; Washington, DC, USA (25 Jun 1984).

31087 (CONF-840677—Summs., pp 134-136) **Sulfolanes as electrolytic solvents for rechargeable lithium batteries.** Foos, J.S.; Rembetsy, L.M.; Brummer, S.B. (EIC Laboratories, Inc., Norwood, MA). Jun 1984. NTIS, PC A11/MF A01. File Number DE84013679.

From 6. DOE battery and electrochemical contractors' conference; Washington, DC, USA (25 Jun 1984).

31088 (CONF-840677—Summs., pp 137-138) **Polymeric electrolytes for ambient temperature lithium batteries.** Farrington, G.C. (Univ. of Pennsylvania, PA). Jun 1984. NTIS, PC A11/MF A01. File Number DE84013679.

From 6. DOE battery and electrochemical contractors' conference; Washington, DC, USA (25 Jun 1984).

31089 (CONF-840677—Summs., pp 142-143) **Novel membranes for lithium batteries.** Litt, M.; Swamikannu, X.; Hsiue, G.H.; Rogers, C.E. (Case Western Reserve Univ., Cleveland, OH). Jun 1984. NTIS, PC A11/MF A01. File Number DE84013679.

From 6. DOE battery and electrochemical contractors' conference; Washington, DC, USA (25 Jun 1984).

31090 (CONF-840677—Summs., pp 148) **Reaction profiles in zinc porous electrodes.** Katan, T.; Carlen, P.J. (Lockheed Missiles and Space Co.). Jun 1984. NTIS, PC A11/MF A01. File Number DE84013679.

From 6. DOE battery and electrochemical contractors' conference; Washington, DC, USA (25 Jun 1984).

31091 (CONF-840677—Summs., pp 149-152) **Semiconductor electrochemistry approach to the study of oxide films on nickel, iron, zinc, and cadmium electrodes.** Madou, M.J.; McKubre, M.C.H.; Wing, S. (SRI International, Menlo Park, CA). Jun 1984. NTIS, PC A11/MF A01. File Number DE84013679.

From 6. DOE battery and electrochemical contractors' conference; Washington, DC, USA (25 Jun 1984).

31092 (CONF-840677—Summs., pp 153-156) **Zinc-nickel oxide battery membrane separator studies and theoretical system analysis and testing.** Bennion, D.N.; Bradshaw, J.S.; Shelton, J.I.; LaFollette, R.M. (Brigham Young Univ., Provo, UT). Jun 1984. NTIS, PC A11/MF A01. File Number DE84013679.

From 6. DOE battery and electrochemical contractors' conference; Washington, DC, USA (25 Jun 1984).

31093 (CONF-840677—Summs., pp 157-161) **Development of multicomponent transport theory and transport data for membranes in concentrated electrolytes.** Bhakta, S.D.; Bennion, D.N. (Brigham Young Univ., Provo, UT). Jun 1984. NTIS, PC A11/MF A01. File Number DE84013679.

From 6. DOE battery and electrochemical contractors' conference; Washington, DC, USA (25 Jun 1984).

31094 (CONF-840677—Summs., pp 162-165) **Research on separators for alkaline zinc batteries.** Yeo, R.S.; Lee, J. (Pinnacle Research Institute, Cupertino, CA). Jun 1984. NTIS, PC A11/MF A01. File Number DE84013679.

From 6. DOE battery and electrochemical contractors' conference; Washington, DC, USA (25 Jun 1984).

31095 (CONF-840677—Summs., pp 166-168) **Supported liquid membrane separators.** Pemsler, J.P.; Dempsey, M.D. (Castle Technology Corp., Woburn, MA). Jun 1984. NTIS, PC A11/MF A01. File Number DE84013679.

From 6. DOE battery and electrochemical contractors' conference; Washington, DC, USA (25 Jun 1984).

31096 (CONF-840677—Summs., pp 169-170) **Cycle-Life testing of porous alkaline zinc electrodes.** Cairns, E.J.; McLarnon, F.R. (Lawrence Berkeley Lab., CA). Jun 1984. NTIS, PC A11/MF A01. File Number DE84013679.

From 6. DOE battery and electrochemical contractors' conference; Washington, DC, USA (25 Jun 1984).

31097 (CONF-840677—Summs., pp 171-172) **Experimental evaluation of the thermodynamic properties of alkaline battery electrodes in concentrated alkali hydroxide solutions.** Johnson, W.B.; Malhotra, M.; Macdonald, D.D.; St. Pierre, G.R. (Ohio State Univ., Columbus). Jun 1984. NTIS, PC A11/MF A01. File Number DE84013679.

From 6. DOE battery and electrochemical contractors' conference; Washington, DC, USA (25 Jun 1984).

31098 (CONF-840677—Summs., pp 173-176) **Electrochemical and morphological study of the effect of temperature on the restructuring and loss of capacity of alkaline battery electrodes.** Lenhart, S.J.; Macdonald, D.D.; Pound, B.G. (Ohio State Univ., Columbus). Jun 1984. NTIS, PC A11/MF A01. File Number DE84013679.

From 6. DOE battery and electrochemical contractors' conference; Washington, DC, USA (25 Jun 1984).

31099 (CONF-840677—Summs., pp 181-182) **Progress in aluminum-air battery development.** Knerr, L.A.; Wheeler, D.J.; Schue, T.J.; Bennett, W.R.; Gestaut, L.J. (ELTECH Systems Corp., Fairport Harbor, OH). Jun 1984. NTIS, PC A11/MF A01. File Number DE84013679.

From 6. DOE battery and electrochemical contractors' conference; Washington, DC, USA (25 Jun 1984).

31100 (CONF-840677—Summs., pp 183-190) **Electrocatalysts for oxygen electrodes.** Yeager, E.; Tryk, D.; Gupta, S.L. (Case Western Reserve Univ., Cleveland, OH). Jun 1984. NTIS, PC A11/MF A01. File Number DE84013679.

From 6. DOE battery and electrochemical contractors' conference; Washington, DC, USA (25 Jun 1984).

31101 (CONF-840677—Summs., pp 191-194) **Iron-air battery development.** Buzzelli, E.S.; Berk, L.B.; Moyes, H.; Zukerbrod, D. (Westinghouse Research and Development Center, Pittsburgh, PA). Jun 1984. NTIS, PC A11/MF A01. File Number DE84013679.

From 6. DOE battery and electrochemical contractors' conference; Washington, DC, USA (25 Jun 1984).

31102 (CONF-840677—Summs., pp 195-197) **Electrochemical phenomena on micro-mosaic electrodes.** Tobias, C.W.; Dees, D.W.; Dukovic, J.O.; Whitney, G.M. (Lawrence Berkeley Lab., CA). Jun 1984. NTIS, PC A11/MF A01. File Number DE84013679.

From 6. DOE battery and electrochemical contractors' conference; Washington, DC, USA (25 Jun 1984).

31103 **(EPRI-EM—3872) Updated cost estimate and benefit analysis of customer-owned battery energy storage.** Stolte, W.J.; Eckroad, S.W. (Bechtel Group, Inc., San Francisco, CA (USA)). Jan 1985. 137p. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $16.00. File Number TI85920552.

Previous phases of EPRI Research Project 1275-12 have shown that, for appropriate load demand situations, commercially available battery systems can be an economically and technically viable approach to load management, providing benefits to both electric utilities and their customers. Phase I (reported in EPRI EM-2769) estimated equipment costs and economic feasibility of generically defined systems. Phase II (EPRI EM-3535) determined economic benefits for sixteen specific utility customer applications. The results of a third phase of the project are presented. Phase I equipment, balance-of-plant (BOP) and operating costs have been refined and a simplified method of estimating economic benefit for specific customer applications is developed. The refined costs and benefit analysis method were based on a relatively detailed conceptual engineering design and cost analysis of a 500 kWh/500 kW lead-acid battery storage plant. Comparison of Phase III costs with the initial Phase I cost estimates indicates that while estimated battery costs have decreased, estimated converter and BOP costs have increased. Maintenance costs are also larger than initially estimated. Although overall estimated system costs have increased over initial estimates, customer-side battery storage plants remain economically attractive for many customer load profiles and existing utility rate structures. A standardized plant design with substantially reduced footprint, to be investigated in Phase IV of the project, would reduce costs and make even more attractive the use of batteries as a load-management tool.

31104 **(N—85-17130) Polymer electrolytes: an investigation of some poly (N-propylaziridine)/lithium salt compositions.** Baldwin, K.R.; Golder, A.J.; Knight, J. (Royal Aircraft Establishment, Farnborough (UK)). Apr 1984. 26p. (RAE-TR—84036). NTIS, PC A03/MF A01.

Poly (N-propylaziridine)/lithium salt compositions were synthesized and their electrical conductivities were measured to assess their suitability as electrolytes in safe, leakproof, high energy-density lithium batteries operating at ambient temperature. The effects on conductivity of temperature, and the nature and concentration of the salt were studied. The salts markedly improve conductivity of the compositions over that of the undoped polymer but they are insufficiently conducting to be considered as battery electrolytes, due possibly to ion pairing. Their creep resistance is also low. Less fluid compositions containing higher molecular weight polymers better able to promote ion separation are more suitable. (ESA)

31105 **(SAND—83-2269) Characterization of sheet calcium for Ca/CaCrO$_4$ thermal batteries.** Guidotti, R.A.; Reinhardt, F.W.; Nelson, G.C. (Sandia National Labs., Albuquerque, NM (USA)). Apr 1985. Contract AC04-76DP00789. 46p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85013231.

The physical and chemical properties of sheet calcium were examined in an attempt to explain the varied performance of different lots in five-cell Ca/CaCrO$_4$ thermal batteries. Properties evaluated included microhardness, phase and texture analysis, heat capacity, melting point, transition temperature, and heat of transition. The surface chemistry was examined by Auger electron spectroscopy, secondary ion mass spectroscopy, and low-energy ion-scattering spectroscopy. None of these properties could be correlated to battery performance. The bulk chemistry of the calcium was characterized by analysis for metallic and interstitial impurities. Only the nitrogen content exerted any measurable influence upon battery performance, with the best overall results observed for samples with >0.40% nitrogen.

31106 **(SAND—83-2334-Rev.) Testing of sealed lead-acid batteries. Revision.** Bush, D.M.; Sealey, J.D.; Miller, D.W. (Sandia National Labs., Albuquerque, NM (USA)). May 1985. Contract AC04-76DP00789. 20p. NTIS, PC A02/MF A01. File Number DE85011804.

Supersedes SAND—83-2334, February 1984.

In early January 1981, Sandia began testing sealed lead-acid batteries which were being developed under Sandia contracts. Goal was to develop a totally maintenance-free sealed lead-acid battery capable of deep-discharge operation in a photovoltaic power system. During contracts with Gould and Eagle-Picher, batteries were received quarterly and placed on test. Testing of these batteries has now been completed. With proper charging, battery life averaged over 800 deep cycles. This was achieved with both the standard NEMA cycle test as well as a partial state of charge test. Charging voltages above 2.50 volts per cell appeared to be detrimental to the performance of the Gould batteries.

31107 **(SAND—84-0799) Final battery evaluation report: Energy Research Corporation zinc/bromine battery.** Butler, P.C.; Miller, D.W.; Robinson, C.E.; Leo, A. (Sandia National Labs., Albuquerque, NM (USA)). Mar 1984. Contract AC04-76DP00789. 194p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE85011144.

The results of an evaluation of an Energy Research Corporation zinc/bromine, flowing electrolyte battery are described. This work was performed at Sandia National Laboratories for the US Department of Energy and the Electric Power Research Institute. Included in the report is a description of the battery, charge/discharge cycle test results, failure analysis investigations, and conclusions summarizing what was learned from the evaluation. Extensive appendices are included with detailed descriptions, data, and failure analyses photographs. The battery operated for 163 charge/discharge cycles with an average electrochemical energy efficiency of 54 +- 10%. The primary causes of failure were electrode de-bonding from flow frame assemblies and non-uniform electrolyte flow distribution.

31108 **(SAND—84-1098) Characterization of cathodic corrosion products in the Ca/CaCrO$_4$ thermal battery.** Guidotti, R.A.; Reinhardt, F.W.; Venturini, E.L.; Rogers, J.W. Jr.; Cathey, W.N. (Sandia National Labs., Albuquerque, NM (USA); Nevada Univ., Reno (USA). Dept. of Physics). May 1985. Contract AC04-76DP00789. 35p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85013442.

Using thermal analysis techniques, we investigated the corrosion process resulting from the reaction of iron, nickel, and stainless steel (used as current collectors in Ca/CaCrO$_4$ thermal batteries) with CaCrO$_4$ dissolved in LiCl-KCl eutectic. The reaction product for iron was synthesized in bulk external to the battery and was characterized by chemical analysis, X-ray diffraction, Moessbauer spectroscopy, X-ray photoelectron spectroscopy, static magnetization, and electrical conductivity. This characterization provides a better understanding of the cathodic corrosion processes that occur in the Ca/CaCrO$_4$ thermal battery, and how the properties of the reaction layer at the catholyte-current collector interface influence battery performance.

31109 **(SAND—85-7194) Cationic exchange membrane for the zinc-ferricyanide battery. Final report.** Pemsler, J.P.; Dempsey, M.D. (Castle Technology Corp., Woburn, MA (USA)). May 1985. Contract AC04-76DP00789. 47p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85013152.

In this one year effort of research into supported-liquid-membrane (SLM) separators for the zinc-ferricyanide battery systems, at least one SLM separator (80% LT27/M80 on 0.13 mm PTFE), has been found that approaches the required specifications with separator resistance in the 2 to 3 ohm-cm^2 range, 1 x 10^{-3} mmoles Fe/h-cm^2 iron transport and 2 x 10^{-4} mmoles Zn/h-cm^2 zinc transport. This separator is still being tested in a 60-cm^2 zinc-ferricyanide battery and is exhibiting encouraging results.

31110 **Batteries.** Cairns, E.J. (Lawrence Berkeley Lab., CA). pp 287-321 of Molten salt technology. Lovering, D.G. (ed.). New York, NY; Plenum Publishing Corporation (1982). Contract W-7405-ENG-48.

This article discusses the use of molten salts in advanced batteries. Molten salts play an important role as electrolyte in several types of batteries that operate at elevated temperatures. Guidelines are presented for the selection of the constituents of electrochemical cells intended to meet the goals of high specific energy, high specific power, and long life. The characteristics, state of development, and areas requiring additional research for the following combinations of negative electrode reactants, electrolytes and positive electrode reactants are discussed: LiAl/LiCl-KCl/FeS_2, Li_4Si/LiCl-KCl/FeS_2, Ca-Al-Si/LiCl-NaCl-$CaCl_2$-$BaCl_2$/FeS_2, Li/Li^+ solid/S, Na/Na^+ solid/S, Na/Na^+ solid/SCl_3AlCl_4 in $AlCl_3$-NaCl, Na/Na^+ solid/S_2Cl_3 in $AlCl_3$.

29 ENERGY PLANNING AND POLICY

31111 **(GAO/RCED—85-41) Corps of Engineers should revise its policy for identifying unneeded land.** (General Accounting Office, Washington, DC (USA). Resources, Community and Economic Development Div.). 22 Mar 1985. 45p. US General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20760. File Number TI85901452.

This report discusses the Corps' program, including the federal land disposal requirements which must be met before land can be sold, and the effect that selling federal land can have on certain users of such land.

31112 **(PB—85-169340/XAB) Energy data and conversion factors - a New Zealand handbook (first edition).** Baines, J.T. (New Zealand Energy Research and Development Committee, Auckland). May 1984. 100p. (REPT—100). NTIS, PC E05/MF E01.

In January 1982, at a meeting of interested parties in Wellington, a decision was taken to compile a booklet of energy conversion factors suitable for planning work (rather than detailed technical work). The main aims underlying the provision of such a booklet are: to encourage the widespread and consistent use of uniform raw energy data and conversion factors by making available a ready-reference handbook appropriate to New Zealand circumstances; and to familiarise non-specialist users of energy data with the important factors that affect the appropriateness and accuracy of energy data. The handbook is not intended to meet the more precise informational needs of detailed technical analysis. Thus it was considered inappropriate to develop the descriptive content in greater detail.

2901 Energy Analysis And Modeling

REFER ALSO TO CITATION(S) 30401, 31143

31113 **(DOE/EIA—0293(85)) Directory of Energy Information Administration model abstracts.** (USDOE Energy Information Administration, Washington, DC. Office of Statistical Standards). May 1985. 60p. NTIS, PC A04/MF A01 - GPO; GPO Dep. File Number DE85013050.

This report presents extended abstracts of active Energy Information Administration (EIA) models. The documentation requirements for active models are described by the EIA in Order EI 5910.3A. Model types within the active category are (1) basic, (2) auxiliary, and (3) developmental. Basic models are ones "designated by the Administrator as being sufficiently important to require sustained support and public scrutiny." Auxiliary models are "used only occasionally in analysis and therefore" require "minimal levels of documentation." Developing models are "... of sufficient interest to require a basic level of documentation at a future date."

31114 **(NP—5750799) Model specifications for energy models used in Scandinavia.** (Nordisk Ministerraad). Nov 1983. 58p. (In several languages). NTIS (US Sales Only), PC A04/MF A01. File Number DE85750799.

A list of energy model programmes used in the Scandinavian countries is presented. Information is given on the institution that has developed the model and a description of the model is also presented. The models are divided into two groups, economic models and technical models. Specially Denmark and Finland have experience with technical models, while Norway and Sweden concentrate on economic models.

31115 **(PB—85-169159/XAB) Regional energy planning: a review. Final report.** (New Zealand Energy Research and Development Committee, Auckland). Jun 1984. 55p. (REPT—106). NTIS, PC E04/MF E01.

This review examines a number of regional energy studies and the approaches being adopted by Regional and United Councils to deal with energy considerations. The importance of energy planning at the regional level is demonstrated together with its relevance to other aspects of regional planning. Guidelines for the identification of energy issues and priorities and effective methods of dealing with these through the regional planning process are suggested.

2902 Economics And Sociology

REFER ALSO TO CITATION(S) 29736, 29778, 29780, 29857, 30100, 30662, 31153, 31159, 31261, 31377

31116 **(N—85-16375) Energy and climate: problems in Latin America.** Barros, V. (Consejo Nacional de Investigaciones Cientificas y Tecnicas, Buenos Aires (Argentina)). 1984. 14p. NTIS MF A01.

In WMO, climate conference for Latin America and the Caribbean, 394-407 p. (N—85-16352 07-47).

The effect of climate on the demand, supply and use of energy in Latin America during the rest of the century is discussed. It is thought that the demand for climatological information on the part of the energy sector will increase and will require the development of suitable techniques for processing the inadequate basic information. The effects related to carbon dioxide release are described. The region's collaboration in international efforts to study this topic is favored. (ESA)

2903 Environment, Health, And Safety

REFER ALSO TO CITATION(S) 29737, 29901, 29961, 30009, 30010, 30660, 30661, 31151, 31366, 31367, 32122, 32125, 32127, 32128, 32129, 32133, 32168, 32190, 32202, 32203, 32204, 32205, 32206, 32207, 32208, 32327, 32380, 32381

31117 **(CERT/TR—82-623) Tribal environmental review process: manual and permits directory.** (Council of Energy Resource Tribes, Englewood, CO (USA)). Dec 1982. Contract FG01-81EV10654. 150p. NTIS, PC A07/MF A01; GPO Dep. File Number DE85012012.

This manual presents a model process for obtaining environmental permits for major energy projects on Indian lands. Environmental approvals for major energy and industrial projects are often characterized by controversy, prolonged and inefficient reviews, and lack of coordination among government agencies. The process described in this manual, called the "tribal environmental review process," was designed to address these problems as well as the unique challenges posed by permitting on Indian lands. In addition, the manual can be used to manage environmental permitting of other major nonenergy projects. The recommended tribal environmental review process offers a flexible, innovative approach to environmental permitting. It is an intergovernmental process to coordinate federal and tribal environmental review procedures for energy projects. The process also promotes active participation by state and local agencies and the public. Four stages - initiation of the process, organization, preapplication coordination, and synchronization of permitting - comprise the process. It is based entirely on existing regulations and participation is voluntary. However, a formal management structure, written agreements, and commitments to a regulatory decision schedule help to ensure full agency participation in the process. A comprehensive analysis of the various federal permit requirements applicable to energy development on Indian lands is presented. Information regarding applicability, permitting application requirements and procedures, environmental standards and conditions, and time frames are described. In addition, a review of federal non-permit requirements that can reasonably be expected to impact energy development on Indian lands is also presented. State and local environmental authorities that should be considered in concert with any large-scale energy project on Indian lands are summarized.

31118 **(CONF-840612—18-Rev.) Forecasting future industrial SO$_2$ and NO/sub x/ emissions. Revised.** Graves, K.; Pechan, E.; Briggs, B.; Turner, D. (Pechan (E.H.) and Associates, Inc., Springfield, VA (USA); USDOE, Washington, DC). 1984. Contract AI01-83PE70494. 16p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85011243.

From Air Pollution Control Association annual meeting; San Francisco, CA, USA (25 Jun 1984).

This paper presents estimates of future emissions from various economic source sectors with a focus on those emissions associated with industrial activities. These estimates were obtained from the Environmental Trends Analysis Model (ETAM). These projections are based on energy and economic projections made by DOE and on data inputs from other sources and models. In this paper we present an overview of sulfur dioxide (SO$_2$) and nitrogen oxide (NO/sub x/) emission trends to the year 2010 from the industrial sector within the context of total anthropogenic emissions. 12 refs., 3 figs., 3 tabs.

31119 **(CONF-8505149—1) Examples of regional environmental assessment using acid deposition data.** Olson, R.J.; Turner, R.S.; Allison, L.J. (Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85012903.

From National conference on hazardous wastes and environmental emergencies; Cincinnati, OH, USA (14 May 1985).

Integrated assessments of acid deposition impacts require data on pollutant emissions, pollutant deposition, air quality, aquatic resources, crops, forests, and manmade materials. These data must have common spatial and temporal attributes that can be readily accessed for statistical analysis, modeling, and display purposes. The Acid Deposition Assessment Staff of Task Group I established the Acid Deposition Data Network (ADDNET) at Oak Ridge National Laboratory to provide accurate and reliable data to conduct assessment and policy analysis for the National Acid Precipitation Assessment Program (NAPAP). Although specific projects and task groups within NAPAP collect and analyze individual data files, ADDNET assembles selected files, verifies their contents, conducts quality assurance, maintains documentation, and makes data available to the NAPAP community. The ADDNET data base contains over 65 'certified' data sets that have been screened to ensure consistency across all areas of the assessment. Two applications of the ADDNET Data Base to assessment activities are described: estimation of the extent of sensitive lakes at risk to high atmospheric deposition and the mapping of regional soil properties according to hypothesized sensitivity criteria. Both examples cover New York and the New England states and show the integration of data from diverse sources for analyses. The data resources and the regional environmental assessment approach described here can be applied directly to other hazardous materials discussed at this symposium. 13 refs., 6 figs.

31120 **Energy and water development appropriations for 1986. Part 8. Hearings before a Subcommittee of the Committee on Appropriations, House of Representatives, Ninety-Ninth Congress, First Session.** Washington, DC; Government Printing Office (1985). 1732p.

Part 8 of the hearing record covers the testimony of Members of Congress and other interested parties on the funding of energy and water projects for fiscal year 1986. The volume opens with the testimony of 20 California congressmen on various projects either underway or proposed for the state. Projects in California, West Virginia, Florida, and elsewhere included flood control, dredging for navigation, research on wave oscillation, hydroelectric power plants and water reservoirs, and erosion control. DOE projects included both nuclear and non-nuclear research programs and power marketing administration. The record covers the testimony of over 700 witnesses, who describe program status, plans, and budget needs.

2904 Natural Resources

REFER ALSO TO CITATION(S) 29851, 31120, 31132

31121 **(DEMO—83/1G) Ground radiometric anomalies of the Serres Basin.** Kyrtsou, C. (Democritos Nuclear Research Center, Athens (Greece)). Jan 1983. 47p. (In Greek). NTIS (US Sales Only), PC A03/MF A01. File Number DE85701220.

This work deals with the geology and radioactivity of a part of the Serres Basin which is made up by the Tertiary sedimentary sequence, peculiar toward the western edge of Rhodope, with lignites occurring locally. The area is transected by three northwesterly trending major faults having a throw of over 150 m. The purpose of this work was the location of as many as possible areas exhibiting a radioactivity much higher than the normal background, as well as their comparison and classification in orders of magnitude. The background radioactivity in the area varies between 150 to 200 c/s; deviations higher than this range area considered to be anomalous. An area of 75 km^2 has been explored where 170 sites exhibiting high radioactivity ranging from 2 to 20 times the background have been located; description of these areas appears in the tables. Of the 170 sites 100 refer to lignite bearing argillaceous sandstone formations, while the rest of them consists of altered sandstones, fossiliferous limestones and other sedimentary sequences.

31122 **(NP—5750806) Report of the Joint Committee for mineral resources in Greenland in the period 1 July 1983-30 June 1984.** (Raastofforvaltningen for Groenland, Copenhagen (Denmark)). 1984. 64p. (In Danish). NTIS (US Sales Only), PC A04/MF A01. File Number DE85750806.

Activities of the Joint Committee for mineral resources in Greenland are reviewed. A number of licenses for oil and gas exploration, granite exploitation and nickel, chromite and ruby minerals recovery have been issued. Hydro power projects, comprehending site selection, meteorologic and hydrologic exploration and environmental impacts of the prospective sites are implemented by the Joint Committee as well as Greenland Geological Survey, and financed by Ministry for Greenland with subsidy from EEC. Coal deposits mining is evaluated. Hydrocarbon exploration is concentrated around Jameson Land.

31123 **(NP—5750812) Specifications of mineral concessions and licences in Greenland as of June 30, 1984.** (Raastofforvaltningen for Groenland, Copenhagen (Denmark)). Jul 1984. 16p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85750812.

In connection with the introduction of Home Rule in Greenland a special mineral resources scheme was established. A Mineral Resources Administration under the Minister for Greenland will be responsible for the major administrative tasks as regards mineral resources. In principle, the mineral resources scheme includes all nonliving natural resources, comprising in particular mineral resources and hydro power. The basis of the mineral resource scheme is to recognize that "the resident population of Greenland has fundamental rights with respect to the natural resources in Greenland". The mineral resources scheme involves a joint decisionmaking power to the State Authorities and to the Home Rule Authorities relating to the essential arrangements with regard to nonliving natural resources in Greenland. The prospecting licence gives the licensee access to the performance of preliminary geological investigations, but it is not connected with any kind of exclusive rights and does not involve priority with regard to future exclusive rights concessions. The exploration concession is an exclusive rights concession and implies in certain circumstances, a right of priority to the concessionaire with regard to any future grants of exploitation rights, provided that as a result of the investigation activities exploitable mineral deposits are found. The exploitation concession is an exclusive rights concession containing detailed terms of further stated exploitation activities. An updated specification of the mineral concessions and licences in Greenland, which are valid as of June 30, 1984, is enclosed. Applications and inquiries concerning mineral resources etc. in Greenland are consequently in the first phase to be addressed to the Mineral Resources Administration.

2905 Research, Development, Demonstration, And Commercialization

REFER ALSO TO CITATION(S) 29771, 29837, 30087, 31178, 31180, 32129

31124 **(AECL—8102) 1982-1983 annual report [Atomic Energy of Canada Ltd.].** (Atomic Energy of Canada Ltd., Ottawa, Ontario). 1983. 64p. NTIS (US Sales Only), PC A04/MF A01. File Number DE85701287.

French version included as AECL-8102F.

Atomic Energy of Canada Ltd. continued to improve on its operating results and financial position with record net earnings of $22.6 million, an increase of 15 percent. Commercial revenue from exports was 53 percent. Revenue from nuclear supply and services declined to $218.9 million as reactor projects neared completion or were deferred. Radiation equipment and isotope sales increased by 25 percent to $84.3 million. This revenue included the first shipment of a Canadian cancer therapy accelerator, isotope production from the new cyclotron, and radiopharmaceutical products. Pickering Generating Station revenue was $38.1 million, an increase of 28 percent. Heavy water production increased by 21 percent and unit operating costs decreased by 9 percent due to increased productivity. Operating profit from commercial operations of $25.8 million was slightly lower, due to increased product development costs and marketing expenses. Studies were made of the long-term behaviour of pressure and calandria tubes in CANDU reactors. Cesium and iodine released from fuel in a hypothetical accident would be retained within the system to a much greater degree than was previously believed, according to other basic research studies. Comprehensive safeguards systems and equipment developed in collaboration with the IAEA were installed on the four 600MW CANDU units which began operating. Experiments testing a process to extract useful by-products from used CANDU fuel were completed using facilities in Italy. Future developments using by-products in combination with uranium or thorium will ensure CANDU's long-term viability.

31125 **(ANL/CNSV-TM—156) Direct and indirect costs arising from implementation of new engines.** Santini, D.J. (Argonne National Lab., IL (USA)). Mar 1985. Contract W-31-109-ENG-38. 67p. NTIS, PC A04/MF A01; GPO Dep. File Number DE85012287.

This report assesses the costs of engine innovation to vehicle manufacturers in particular and to the nation's economy (where all manufacturers introduce new engines simultaneously) in general. The costs of a new passenger-car internal-combustion engine (ICE), including associated transmission costs, are estimated to be $0.8 to 1.4 billion (1981 dollars). The economical volume of production is estimated to be 250,000 units annually. The rate of introduction of new engines - examined over several decades - is found to be highly variable, but the process is synchronized across all manufacturers (simultaneous introduction); changes in fuel cost and quality provide the synchronizing mechanism. Simultaneous introduction of new engines and fuels drives up the real costs of vehicle ownership; the consequent withdrawal of consumers from the marketplace causes vehicle output to fall sharply. Depending on the severity of the cost increases and the duration of the engine-introduction period, the indirect costs to the nation may include a recession, a "stagnation," or a depression. A historical review (including the nineteenth century) shows that this phenomenon is quite general in nature. Advanced research leading to lower costs and greater success in the introduction of new engines could help reduce the indirect costs to the nation. Successful engine innovations improve vehicular efficiency and performance, boosting long-term economic growth. The desirability of research on two innovative automotive engines - the Brayton-cycle and Stirling engines - is assessed.

31126 **(DOE/CE—0111) Geothermal energy technology program summary.** (Conservation and Renewable Energy Inquiry and Referral Service, Silver Spring, MD (USA)). May 1985. Contract AC01-83CE30780. 4p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85013101.

FS 200, 1st Edition.

The progress to date of the geothermal energy program of the US Department of Energy is briefly summarized, including federal/industry cooperation, program focus, and a budget summary. (ACR)

31127 **(DOE/CE—0122) National Awards Program for Energy Innovation 1984. Project descriptions.** (USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC). 1985. 404p. NTIS $18.25/MF A01; 1; GPO Dep. File Number DE85011096.

This collection of outstanding energy projects is the result of a nationwide search for innovative programs and technologies which began in the fall of 1983, when the Department of Energy (DOE) launched the National Awards Program for Energy Innovation. These projects were already underway as schools, companies, communities, and other organizations looked for ways to reduce their energy bills. As part of Technology Transfer 80's, DOE's program to encourage the sharing of energy-saving accomplishments and technologies, we decided to work with the Governors and their Energy Offices to identify and publicize innovative energy-saving ideas. The projects presented in this book were selected by the Governors and nominated for National Awards. Those marked with asterisks received Special Recognition Awards.

31128 **(DOE/METC—84-23, pp 631-633) United States Trade and Development Programs in transferring United States technology.** Bobel, R. Jun 1984. NTIS, PC A99/MF A01. File Number DE84009251. (CONF-8010382—).

From Morocco/United States oil shale colloquium; Rabat, Morocco (1 Oct 1980).

The US Government's Trade and Development Program and how it tries to advance the difficult process of world economic development is discussed. The purpose of the Trade and Development Program, or TDP, is to promote technology cooperation between the US and, principally, the more rapidly-developing middle income countries, such as Morocco. The main task is to stimulate technology transfer from the US from simplest technologies to the highest technologies. Over the next two fiscal years the total budget for program operations on a worldwide basis is limited to $12 million. The types of activities that TDP can engage in include the following: on a selected basis, invitational travel for foreign officials considering a major project investment to visit the US to view US technology and operations; second, technical symposia, such as this one; and third, project preparations services, ranging from project identification and definitional studies through pre-feasibility studies to full feasibility studies. IDP does not finance final design, nor the operational costs of projects. Trade and Development Program financing is usually offered on a grant basis either through direct contact with American firms or other US government agencies or by passing funds to host governments, which then select American firms or Americans in association with local partners to carry out project studies.

31129 **(NP—5901429) Hawaii Natural Energy Institute annual report, 1984.** (Hawaii Univ., Honolulu (USA). Hawaii Natural Energy Inst.). 1984. 184p. University of Hawaii at Manoa, Honolulu, HI. File Number TI85901429.

This tenth anniversary special reviews each project over the past 10 years, with research in progress included for FY83-84 for biomass, geothermal, ocean energy, solar energy, wind research and other renewable energy research. (PSB)

31130 **(RISO-M—2442) Health Physics Department annual progress report 1 January-31 December 1983.** (Risoe National Lab., Roskilde (Denmark)). Aug 1984. 39p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85701288.

The report describes the work of the Health Physics Department at Risoe during 1983. The activities cover dosimetry, instrumentation, radioecology, risk by nuclear activities and nuclear emergency preparedness. Lists of staff and publications are included. A great deal of the work in the department is of minor interest to people outside Risoe as it represents service functions. Therefore, the main emphasis in the report has been placed on scientific and contractual work.

31131 **Department of Energy Civilian Energy Programs Authorization Act for fiscal years 1986, 1987, and 1988. Part 1. A report submitted to the House of Representatives, Ninety-Ninth Congress, First Session, April 22, 1985.** Washington, DC; Government Printing Office (1985). 101p.

The House Committee on Science and Technology report on legislation authorizing DOE appropriations (H.R.1799) suggests several amendments to line item amounts. The report describes the background of the bill and the hearings and actions of the committee. The bulk of the report is devoted to the programs covered by the legislation, including research and development on energy conservation, renewable energy sources, fossil energy, nuclear energy, high energy and nuclear physics. The report analyzes and compares the proposed budget of $5872 million in 1986, $6359 million in 1987, and $6393 million in 1988 with one developed by the Congressional Budget Office. Estimated receipts reduce the net outlays to $1064 million, $3692 million, and $4411 million for the respective years. Additional and dissenting views appear at the end of the report.

31132 **Authorizing appropriations to the Department of Energy for civilian energy programs for fiscal year 1986 and fiscal year 1987, and for other purposes. A report to the House of Representatives, Ninety-Ninth Congress, First Session, May 15, 1985.** Washington, DC; Government Printing Office (1985). 18p.

The Committee on Interior and Insular Affairs report on H.R. 2041 is favorable toward the authorization of DOE civilian nuclear and non-nuclear energy projects in the 1986 budget. There are a number of amendments which adjust budget figures either up or down. The committee approved expenditures of $2613.3 million out of the $2622.5 million of the $5495 million budget request over which it has jurisdiction. Significant changes were a decrease in light water reactor technology and departmental administration, and an increase in low-level nuclear waste technology and power marketing administration. The report explains the justifications for these changes, such as changes in the world enriched uranium market, and estimates the net cost to the government at $3563 million. The report compares 1985 appropriations, 1986 requests, and 1986 appropriations. 6 tables.

2906 Nuclear Energy

REFER ALSO TO CITATION(S) 29918, 29961, 30009, 30010, 30743, 30769, 31256, 32107

31133 **(AD-A—151602/0/XAB) Nuclear winter: environmental and human consequences of nuclear war - a selected bibliography.** (Army War Coll., Carlisle Barracks, PA (USA)). Feb 1985. 8p. NTIS, PC A02/MF A01.

Existing studies by Soviet and American scientists have concluded that nuclear war might cause a global climatic catastrophe. The effects of nuclear war on the climate are being investigated and suggest a massive death of plants, animals and humans in ice-age conditions that would last for more than a year. Although there is increasing emphasis on this catastrophic hypothesis, a dearth of literature has been published to date. Researchers will find that the references cited in this bibliography constitute a basis for a beginning evaluation of the subject. Both pro and con viewpoints of this new hypothesis are presented in the bibliographic citations. The list is not comprehensive and contains only material which is readily available in the USAWC Library collection.

31134 **(DOE/EA—0270) Environmental assessment: the proposed settlement of Washington Nuclear Project No. 3 lawsuits.** (USDOE Bonneville Power Administration, Portland, OR. Office of Power and Resources Management). May 1985. 108p. NTIS, PC A06/MF A01; GPO Dep. File Number DE85012983.

Details of the proposed settlement are presented where the key issues are: (1) BPA's alleged obligation to fund completion of WNP-3 from revenues; (2) the Supply System's obligation to construct WNP-3 to completion; (3) whether delay will increase costs to complete the plant; and (4) the utilities' need for power from the plant.

31135 **(DOE/S—0035) Light-water reactor research and development.** (USDOE Office of Energy Research, Washington, DC. Energy Research Advisory Board). May 1985. 71p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85013255.

This report on the national program of research and development on light water reactors is the second of two reports requested in 1982 by W. Kenneth Davis, Deputy Secretary of the Department of Energy. A first report, published in September 1983, treated the needs for safety-related R & D. In this second report, the Energy Research Advisory Board finds that, although many light water reactors are providing reliable and economic electricity, it appears unlikely that U.S. utilities will order additional reactors until the currently unacceptable economic risk, created by the regulatory climate and uncertain demand, is reduced. Thus it is unlikely that the private sector alone will fund major LWR design improvements. However, nuclear power will continue on its current course of expansion overseas. DOE participation is vitally needed to support the national interest in LWR technology. The report outlines R and D needs for a program to improve the safety, reliability, and economics of the present generation of plants; to develop evolutionary improved designs to be ready when needed; and to explore innovative longer-term concepts for deployment after the year 2000. The respective roles of government and the private sector are discussed.

31136 **Energy and water development appropriations for 1986. Part 7. Hearings before a Subcommittee of the Committee on Appropriations, House of Representatives, Ninety-Ninth Congress, First Session.** Washington, DC; Government Printing Office (1985). 1266p.

Part 7 of the hearing record covers three areas of the DOE appropriations: Atomic Energy Defense activities, power marketing administrations, and departmental administration. Representatives of DOE and the US Army reviewed the nuclear defense mission and activities under the defense and arms control programs. The administrators of the Alaska, Bonneville, Southeastern, Southwestern, and Western Power Administrations and a representative of the Conservation and Renewable Energy division described programs and budget requirements, as well as estimates of power demands for their regions. Administrative personnel described DOE procedures and explained the budget requests. Supporting documentation accompanies the testimony of the 16 witnesses.

2907 Transport And Storage

REFER ALSO TO CITATION(S) 30666

2908 Waste Heat Utilization

REFER ALSO TO CITATION(S) 31274, 31349, 31351

2910 Conservation

REFER ALSO TO CITATION(S) 31190, 31261, 31280, 31281, 31286, 31287, 31288, 31289, 31290, 31291, 31292, 31293, 31294, 31295, 31296, 31377, 31378

2920 Supply, Demand, And Forecasting

REFER ALSO TO CITATION(S) 29777, 31115, 31154

31137 (DOE/METC—84-23, pp 23-30) **Energy situation in Morocco and its perspectives.** Sdiqui, M. (Ministry of Energy and Mines, Morocco). Jun 1984. NTIS, PC A99/MF A01. File Number DE84009251. (CONF-8010382—).

From Morocco/United States oil shale colloquium; Rabat, Morocco (1 Oct 1980).

The energy situation in Morocco and its perspectives for the future are summarized. Morocco's supplies of energy are ensured by the following primary resources: hydroelectric, coal, crude petroleum, and natural gas. The first three of these resources are domestic, the fourth almost entirely imported. The prospects for developing hydro, coal, and petroleum resources are discussed.

31138 (DOE/METC—84-23, pp 31-48) **Review of the US energy situation.** Schora, F.C.; Seay, J.G. (Gas Development Corp., Chicago, IL). Jun 1984. NTIS, PC A99/MF A01. File Number DE84009251. (CONF-8010382—).

From Morocco/United States oil shale colloquium; Rabat, Morocco (1 Oct 1980).

The growth rate of energy consumption in the US has declined sharply due to the combined effects of the recession, higher energy prices, and conservation. Projections of future energy consumption are much lower than previous forecasts. On the supply side, oil and gas drilling is up sharply and additions to reserves are increasing. Coal output is rising and oil imports have declined. Crude oil production from Prudhoe Bay in Alaska is over 1.6 million barrels per day; the Alaska Gas Pipeline project is under way; and imported LNG is expected to provide an increasing increment of gas supply, provided contractual and environmental problems can be resolved. Creation of the Synthetic Fuels Corporation will provide a major impetus to synthetic fuels development and a large, broadly-based energy research, development and demonstration program is beginning to provide new energy options.

31139 (EFN—10) **Energy forecasts, perspectives and methods.** Svensson, J.E.; Mogren, A. (Energiforskningsnaemnden, Stockholm (Sweden)). 1984. 198p. (In Swedish). NTIS (US Sales Only), PC A09/MF A01. File Number DE85750835.

The authors have analyzed different methods for long term energy prognoses, in particular energy consumption forecasts. Energy supply and price prognoses are also treated, but in a less detailed manner. After defining and discussing the various methods/models used in forecasts, a generalized discussion of the influence on the prognoses from the perspectives (background factors, world view, norms, ideology) of the prognosis makers is given. Some basic formal demands that should be asked from any rational forecast are formulated and discussed. The authors conclude that different forecasting methodologies are supplementing each other. There is no best method, forecasts should be accepted as views of the future from differing perspectives. The primary prognostic problem is to show the possible futures, selecting the wanted future is a question of political process.

31140 (ERG-MR—2e) **Energy demand patterns.** Hoffmann, L.; Schipper, L.; Meyers, S.; Sathaye, J.; Hara, Y. (Energy Research Group, Ottawa (Canada)). May 1984. 55p. Energy Research Group, P.O. Box 8500, Ottawa K1G 3H9, Canada. File Number TI85901445.

This report brings together three papers on energy demand presented at the Energy Research Priorities Seminar held in Ottawa on 8-10 August 1983. The first paper suggests a framework in which energy demand studies may be organized if they are to be useful in policy-making. Disaggregation and the analysis of the chain of energy transformations are possible paths toward more stable and reliable parameters. The second paper points to another factor that leads to instability in sectoral parameters, namely a changeover from one technology to another; insofar as technologies producing a product (or service) vary in their energy intensity, a technological shift will also change the energy intensity of the product. Rapid technological change is characteristic of some sectors in developing countries, and may well account for the high aggregate GDP-elasticities of energy consumption observed. The third paper begins with estimates of these elasticities, which were greater than one for all the member countries of the Asian Development Bank in 1961-78. The high elasticities, together with extreme oil dependence, made them vulnerable to the drastic rise in the oil price after 1973. The author distinguishes three diverging patterns of national experience. The oil-surplus countries naturally gained from the rise in the oil price. Among oil-deficit countries, the newly industrialized countries expanded their exports so rapidly that the oil crisis no longer worried them. For the rest, balance of payments adjustments became a prime concern of policy. Whether they dealt with the oil bill by borrowing, by import substitution, or by demand restraint, the impact of energy on their growth was unmistakable. The paper also shows why energy-demand studies, and energy studies in general, deserve to be taken seriously. 16 refs., 4 figs., 18 tabs.

31141 (NP—5750860) **Energy systems. Domestic energy sources of the province of Kronoberg.** (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). [1985]. 94p. (In Swedish). NTIS (US Sales Only), PC A05/MF A01. File Number DE85750860.

In cooperation with the local authorities in Kronobergs administrative province.

The location, size and availability of energy sources of the province of Kronoberg and its energy demandand future energy systems by the year 1990 and 2000 are presented. The resources include peat, wood and waste. The total area for peat mining is calculated to be 16200 ha, equivalent to 6000 GWh, 6.5 percent of it will be exploited by the year 2000. Some export of domestic fuels from Kronoberg is expected and the refining of fuels will be established.

31142 (RAND/N—2295-DOE) **International energy emergency system: issues and sources.** Kohler, D.F.; Trautman, W.B.; Doyle, M.A. (RAND Corp., Santa Monica, CA (USA)). May 1985. Contract AC01-82EP12128. 119p. NTIS, PC A06/MF A01; GPO Dep. File Number DE85013273.

This Note serves two functions. First, it provides a brief discussion of some of the issues surrounding the role of prices in an international energy emergency, and the way in which the International Energy Agency approaches them. Second, it offers summaries of some of the literature dealing with the International Energy Agency, and the ways in which it plans to influence oil markets and prices in the event of an energy emergency.

31143 (SOU—1983:19-Abst.) **Great transition. An analysis of international energy markets.** (Statens Energiverk, Stockholm (Sweden)). 1983. 72p. NTIS (US Sales Only), PC A04/MF A01. File Number DE85750831.

In the beginning of 1981, the Swedish Government appointed Carl Tham, former Minister of Energy and currently Director of National Energy Administration, to explore the development of the international energy markets, with special reference to the impact on conditions for Swedish energy supply. Assisted by a sectretariat - Johan Lind, Olle Bjoerk and Maarten Grunditz - and an export committee, Carl Tham conducted the analysis during a turbulent period of the world oil market history, characterized by declining oil prices and revised energy projections. Working in a political and intellectual climate where the conventional wisdom of the recent past occasionally seemed to be very quickly outdated, the investigation was completed in the winter of 1982-83. The final report - written in Swedish and endtitled The Great Transition - an analysis of international energy markets, - was published in the spring of 1983. The analysis undertaken by Carl Tham and his secreteriat benefitted considerably from extensive communications and discussions with government officials, international organizations, business executives, academic scholars and other specialists. In order to provide all of these people - as an expression of deep appreciation of their assistance - as well as others not familiar with the Swedish language with an opportunity to evaluate the main conclusions reached as a result of the analysis this summary in English is published by the National Energy Administation and presents an overview of the contents of the unabridged report. One chapter (chapter 18), which summarizes Carl Thams own conclusions as to the current and future development of the International oil market, is, however, translated in full.

2930 Policy, Legislation, And Regulation

REFER ALSO TO CITATION(S) 29789, 29857, 31117, 31120, 31123, 31131, 31132, 31136, 31151

31144 (CONF-8410179—, pp 247-253) **Geothermal development in an era of excess capacity.** Grew, P.C. (California Public Utilities Commission, San Francisco). 1984. NTIS, PC A16/MF A01. File Number DE85008202.

From DOE geothermal technology conference; El Centro, CA, USA (16 Oct 1984).

The purchase by utilities of power produced by non-utility companies such as several of the geothermal energy firms is discussed in detail. The role of regulatory bodies in the process is examined and the difficulties presented by the current excess capacity are described.

31145 (CONF-8410179—, pp 255-258) **Geothermal Program Review: luncheon speech.** Collins, P. (Dept. of Energy, Washington, DC). 1984. NTIS, PC A16/MF A01. File Number DE85008202.

From DOE geothermal technology conference; El Centro, CA, USA (16 Oct 1984).

Our national energy policy, how renewable energy fits into it, and the key role that geothermal energy can play in achieving the national energy goals were the topics of this luncheon address.

31146 **(DOE/IR/10334—T1) Series of conferences of state and local government officials.** (Littlejohn (Roy) Associates, Inc., Washington, DC (USA)). [1982]. Contract FG01-80IR10334. 256p. NTIS, PC A12/MF A01; 1; GPO Dep. File Number DE85012411.

The basis for analyzing this study was a survey that solicited information from public officals located in the 50 states and territories subject to US jurisdictions. A communique was sent to these individuals requesting responses to eight major areas. These public officials were also asked to provide information that focused upon conservation incentives, energy programs and energy legislation. Information requested from the participants was as follows: Executive branch energy pronouncements and policy statements; energy legislation; building codes, zoning ordinances and other administrative regulations dealing with energy; non-federal energy management programs; unilateral energy initiatives, i.e., undertaken without specific federal program direction and funding; publications and documents; other examples of unique methods of addressing energy challenges and opportunities; and energy policy positions formally adopted by organizations representing state, local and Indian governments.

31147 **(NP—5770297) Cuba - energy situation 1983.** (Bundesstelle fuer Aussenhandelsinformation, Koeln (Germany, F.R.)). Feb 1985. 11p. (In German). NTIS (US Sales Only), PC A02/MF A01. File Number DE85770297.

The energy situation of Cuba is reviewed on the basis of relevant data. Some remarks on the country's national and international energy policy are followed by an outline of trends in petroleum consumption and electric power generation. Important figures are presented on external trade and the balance of payments.

31148 **(NP—5770298) India - energy situation 1983/1984.** (Bundesstelle fuer Aussenhandelsinformation, Koeln (Germany, F.R.)). Feb 1985. 20p. (In German). NTIS (US Sales Only), PC A02/MF A01. File Number DE85770298.

The energy situation of India is reviewed on the basis of relevant data. Some remarks on the country's national energy policy are followed by an outline of trends in energy sources and electric power generation. Important figures are presented on external trade and the balance of payments.

31149 **(NP—5770299) Austria - energy situation 1983.** (Bundesstelle fuer Aussenhandelsinformation, Koeln (Germany, F.R.)). Mar 1985. 25p. (In German). NTIS (US Sales Only), PC A02/MF A01. File Number DE85770299.

The energy situation of Austria is reviewed on the basis of relevant data. Some remarks on the country's national and international energy policy are followed by an outline of trends in energy sources and electric power generation. Important figures are presented on external trade and the balance of payments.

31150 **More ado about prehearing discovery at FERC.** Benkin, I.D. (Federal Energy Regulatory Commission, Washington, DC). *Energy Law Journal;* 6: No. 1, 1-31(1985).

A rich tradition of prehearing discovery has grown up at the Federal Energy Regulatory Commission (FERC) despite the absence of procedural rules. Proposed discovery rules generally run in the mainstream, but the author also discusses some aspects of discovery practice at FERC that are not codified or proposed to be codified. A recent decision of the Ninth Circuit Court of Appeals clarified the legal status of the FERC's discovery rules. In Pacific Gas and Electric Co. vs. FERC, the court held that the agency is not required to provide for discovery. It also stated that if the agency's rules do contain provisions for discovery, those rules become binding and the agency must comport with due process. The author describes the effort to codify rules as a healthy development that demonstrates FERC's commitment to the adjudicative process for deciding important issues.

2940 Fossil Fuels

REFER ALSO TO CITATION(S) 29737, 29739, 29742, 29742, 29743, 29743, 29744, 29744, 29771, 29777, 29778, 29779, 29780, 29781, 29781, 29788, 29788, 29789, 29798, 29801, 29808, 29837, 29853, 31118, 31122

31151 **(CONF-850444—3) Applying multidisciplinary policy analysis to factors affecting coal use.** Surles, T.; Streets, D.G.; Tisue, M. (Argonne National Lab., IL (USA)). 1985. Contract W-31-109-ENG-38. 30p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85012123.

From Newer coal technologies: implications for energy and development policies in Asia and the Pacific; Honolulu, HI, USA (17 Apr 1985).

The use of multidisciplinary analysis techniques in policy analysis is described. Integrated assessments are also used by countries to integrate the results of studies in various areas surrounding energy use. The discussion addresses development of coal resources and increased coal use. Multidisciplinary analysis includes environmental, industrial, and technology assessments. A case study on acid precipitation is presented since it is of grave concern in North America. The environmental limitations on coal use will require multidisciplinary policy analysis to evaluate the technological changes and to assess economic and environmental trade-offs. 7 refs., 11 figs., 1 tab. (DMC)

31152 **(DOE/CS/60038—11) Indiana energy facts.** (Indiana Dept. of Commerce, Indianapolis (USA). Div. of Energy Policy). [1985]. Contract FG02-76CS60038. 33p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85011991.

This document contains data on energy production, consumption, and prices in Indiana from 1960 to 1982. Prime energy supplies investigated are electric power, petroleum, coal and natural gas. No text is included. 2 figs., 26 tabs.

31153 **(DOE/EI/19685—T1) State heating oil program: final report. Survey of No. 2 heating oil prices and inventories at the retail and wholesale levels, October 1, 1984-May 1, 1985.** (Vermont State Energy Office, Montpelier (USA)). 1985. Contract FG01-84EI19685. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85013246.

Results of a survey of residential heating oil prices and inventories in Vermont are reported. Price and inventory of No. 2 distillate fuels were monitored at the retail and wholesale levels on a monthly, weekly or bi-weekly basis from October 1, 1984 through May 1, 1985. The survey data were collected via telephone calls to a sample of fuel oil suppliers throughout the state. The sample selection was completed by the Energy Information Administration (EIA), who also weighed and analyzed the collected data.

31154 **(ERG-MR—1e) Oil prospect.** Ion, D.C.; Odell, P.R.; Mossavar-Rahmani, B. (Energy Research Group, Ottawa (Canada)). Mar 1984. 57p. Energy Research Group, P.O. Box 8500, Ottawa K1G 3H9, Canada. File Number TI85901446.

Three papers presented at the Energy Research Priorities Seminar held in Ottawa on August 8, 1983 are included in this report. All address the prospects of oil. In the first paper, the best available estimates of oil and gas reserves and output in developing countries are summarized. Forecasts on prices and demand are included. The second paper addresses the nature and implications of the oil crisis for developing countries. Both papers conclude that oil prices are determined by collusion between the major producing and consuming countries. Prices are fixed high so that ultimate demand will fall short of the ultimate reserve. The third paper discusses prospects for OPEC oil in the 1980's. It concludes that the world oil market is fragmented, and what is regarded as the world price of oil is only the price of the small proportion of oil exported by OPEC countries. Major consuming countries give preference first to indigenous oil and then to oil from safe sources - which the OPEC countries are not, in their view. Hence the demand for OPEC oil varies more violently than total demand and so does the price of their oil. 26 refs., 14 figs., 15 tabs. (DMC)

31155 **(VTT-TUTK—279) Present exploitation technology and research needs of domestic fuels.** Mutanen, K.; Sahrman, K. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). May 1984. 134p. (In Finnish). Valtion Teknillinen Tutkimuskeskus, Espoo (Finland).

The aim of the study was to survey energy research related to domestic fuels carried out during the time period 1979-1982 and the need for research and development of technology over the next three to four years. Since the late 70's 80 million Finnish marks have been directed to the research of domestic fuels from public funds. All sections of the domestic fuels operation chain can be supplied with commercial equipment. However, the domestic fuels are not competitive economically in all sectors of business. There is need to develop equipment, methods and entire systems. (In Finnish)

2950 Hydrogen And Synthetic Fuels

31156 **(NP—5901712) Ethanol policy issues facing Iowa and the midwest.** (Iowa Energy Policy Council, Des Moines (USA)). [1985]. 17p. NTIS, PC A02/MF A01. File Number DE85901712.

Changing state and federal government policies have produced an unstable market. The problem of imported ethanol and fragmented state policies can be solved by having states eliminate their tax incentives and have the federal government increase their incentive to at least 80 cents a gallon of ethanol and place a tariff on imports. The price of ethanol must reflect its octane value. Major refiners must be committed to use ethanol as an octane enhancer, and investments in terminal storage and blending equipment must be made. The 80 cents a gallon value is justified because the ethanol industry provides a stable market for agricultural products and protects the environment by replacing lead in gasoline. (DLC)

2960 Electric Power

REFER ALSO TO CITATION(S) 29736, 30244, 30660, 30661, 30662, 31118, 31134, 31136, 31152, 32125

31157 **(DOE/EIA—0226(85/02)) Electric Power Monthly, February 1985.** (USDOE Energy Information Administration, Washington, DC. Office of Coal, Nuclear, Electric and Alternate Fuels). May 1985. 45p. NTIS, PC A03/MF A01; 1 - GPO; GPO Dep. File Number DE85011764.

During February 1985, net generation by electric utilities in the United States was 198,121 gigawatthours (GWh). On a year-to-date basis, net generation at the end of February 1985 was 4.8% higher than for the same period in 1984. In February 1985, coal accounted for 56.5% of all electricity produced, petroleum for 4.7%, gas for 9.8%, hydroelectric power for 13.1%, nuclear power for 15.6%, with the remaining 0.4% from geothermal, wood, wind, and solar. In February 1985, electric utilities consumed 55,463 thousand short tons of coal. Petroleum consumption was 16,044 thousand barrels, while gas consumption was 201,160 million cubic feet. On a year-to-date basis, coal consumption at the end of February 1985 was 5.9% higher than that for the same period in 1984; petroleum consumption was 15.7% lower than during the same period in 1984; and gas consumption was 5.9% higher.

31158 **(DOE/EIA—0226(85/03)) Electric Power Monthly, March 1985.** (USDOE Energy Information Administration, Washington, DC. Office of Coal, Nuclear, Electric and Alternate Fuels). Jun 1985. 44p. NTIS, PC A03/MF A01 - GPO; GPO Dep. File Number DE85013431.

During March 1985, net generation by electric utilities in the United States was 194,707 gigawatthours (GWh). On a year-to-date basis, net generation at the end of March 1985 was 2.4% higher than for the same period in 1984. In March 1985, coal accounted for 57.1% of all electricity produced, petroleum for 3.7%, gas for 10.2%, hydroelectric power for 12.6%, nuclear power for 15.9%, with the remaining 0.5% from geothermal, wood, wind, waste, and solar. In March 1985, electric utilities consumed 54,690 thousand short tons of coal. Petroleum consumption in March 1985 was 12,294 thousand barrels, while gas consumption was 206,247 million cubic feet. On a year-to-date basis, coal consumption at the end of March 1985 was 4.1% higher than that for the same period in 1984; petroleum consumption was 20.7% lower than during the same period in 1984; and gas consumption was 3.9% higher.

31159 **(DOE/IE—0003/1) Electric power supply and demand for the contiguous United States, 1985-1994. Staff report.** (USDOE Assistant Secretary for International Affairs and Energy Emergencies, Washington, DC). May 1985. 193p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE85013410.

This report reviews the bulk electric power supply and demand situation projected by the electric utility industry for the contiguous US in the decade 1985 to 1994. The review is based primarily on the April 1, 1985 Regional Reliability Council Coordinated Bulk Power Supply Program Reports (IE-411 reports) submitted to the Department of Energy by each of the nine Regional Electric Reliability Councils. Other sources of information have also been used. The first map in Appendix 1 shows the geographic areas covered by each council. Six Council areas are subdivided into a total of 23 Regions to give a better understanding of the power supply situation. Three Council areas (ERCOT, MAAC and MAPP) are each considered as a single Electrical Region. Including the three councils considered as Regions, there are 26 Electric Regions discussed in this report. These Regions are shown on the second map in Appendix 1. Appendix 3 lists the utilities in each Region for which data are included in this report. Brief discussions are provided for each Council and each Region, with tabulated data providing the quantitative basis for the analyses. 63 tabs.

31160 **(DOE/NBM—5009058) Operating and financial profile report of the electric utility industry in the United States.** (Federal Energy Regulatory Commission, Washington, DC (USA). Office of Electric Power Regulation). Apr 1985. 51p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85009058.

In accordance with Order No. 389, Generic Rate of Return on Common Equity for Electric Utilities, 49 Fed. Reg. 29,946 (July 25, 1984), this profile report was written and describes the financial and operating circumstances of the electric utility. The information contained in this report provides the kind of data necessary to analyze industry trends and determine whether a company is significantly more or less risky than the electric utility industry average, if litigation ensues on that issue in an individual rate case.

31161 **(DOE/RA/50223—T1) Research on uncertainty for industry functional modelling. Final report.** Fine, T.L.; Thorp, J.S. (Cornell Univ., Ithaca, NY (USA). School of Electrical Engineering). Apr 1985. Contract AC01-80RA50223. 24p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85011239.

Thrust has been to develop those new concepts of probability that show promise of being able to model some of the significant sources of uncertainty encountered in a power system or electric utility operation that are not well-modeled by the usual concept of numerical probability as formalized by Kolmogorov. Examples of relevant sources of uncertainty that are not amenable to conventional probabilistic models include most variables encountered in long term forecasts and in modeling such natural phenomena as weather and the availability and distribution of fuel resources. Our research has primarily focussed on the relatively new and little explored concept of interval-valued or upper and lower probability (U/LP). The axiomatic structure of U/LP may be thought of as a pair of nonnegative numbers in the unit interval that simultaneously represent the tendency for an event in question (interval midpoint, say) to occur and our lack of knowledge concerning this tendency (interval width). We have contributed to the development of the theory associated with U/LP in such areas as the generation of useful and tractable specific models (e.g., analogues to specific probability models like the Gaussian), the calculus of the random quantities described by U/LP (e.g., sums of random variables), and attempted to develop better definitions of independence and conditioning (learning from experience). We have applied the concept of U/LP to the problem of aggregating group/expert opinion so as to better represent the state of knowledge of an electric utility planning group doing long range planning and forecasting. We believe that our research has been successful in this area in that we can formally represent both consensus and disagreement in the opinions of a group of experts whereas the approaches based upon the conventional notion of numerical probability cannot display disagreement.

31162 **(DOE/RG/10241—T1) Power plant performance in Massachusetts: analysis and recommendations.** (Massachusetts Dept. of Public Utilities, Boston (USA); Barry (Theodore) and Associates, Los Angeles, CA (USA)). Jul 1981. Contract FC01-79RG10241. 139p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE85010815.

Activities were carried out in establishment of a Power Plant Productivity Program as part of the second year of the PURPA-related activities. The program established a productivity data base for generating units with a capacity of more than 60 MW. We employed a questionnaire to collect data on the following parameters: heat rate, operating availability, equivalent availability, capacity factor, output factor and forced outage rate. The verified data was statistically analyzed in order to review the productivity of generating units over a ten-year period (1970 to 1980) and to identify any trends. The analysis identified the following trends: Heat rates have increased throughout the period for each company and on a statewide basis. Operating availabilities, equivalent availabilities, capacity factors, and output factors remained relatively constant or declined during the period. Forced outage rates trended upward during the period. Overall performance of fossil-fired units declined in the State of Massachusetts during the period from 1970 to 1980. Goals are established to arrest declining productivity and establish a starting point for improving performance.

31163 **(DOE/RG/10406—T4) End-use results for Public Utility District No. 1 of Chelan County.** (Economic and Engineering Services, Inc., Bellevue, WA (USA)). Mar 1982. Contract FG01-80RG10406. 78p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85012435.

This is the final documentation for the end-use econometric analysis prepared for Chelan County PUD, Washington. Objective was to develop a statistical procedure for constructing current and future end-use forecasting models. Data analysis was conducted in steps: elimination of data inconsistencies, generation of correlation matrix and regressions relating kWh consumption and end-use variables, and derivation of a final end-use model. (DLC)

31164 **(DOE/RG/10406—T5) Chelan County Pud formal educational services, Topic B.3 - project valuation techniques; Topic B.4 - optimum electric pricing.** (Economic and Engineering Services, Inc., Bellevue, WA (USA)). 5 Nov 1981. Contract FG01-80RG10406. 102p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE85012436.

This document contains notes on: pricing, optimality, linear programming, present value issues, loss of load probability, inverse elasticity, avoided costs, marginal costing, and proposed voluntary guideline on the PURPA cost of service standard. (DLC)

31165 **(DOE/RG/10406—T6) Documentation manual for automated cost of service: Public Utility District No. 1 of Chelan County.** (Economic and Engineering Services, Inc., Bellevue, WA (USA)). Aug 1982. Contract FG01-80RG10406. 140p. NTIS, PC A07/MF A01; GPO Dep. File Number DE85012437.

Three basic cost of service programs were evaluated; the New York Department of Public Service program was found to meet or exceed all standards. A manual computation of the District's revenues and expenses for a period of one year was conducted. The automated average embedded computer model is discussed. Programs required to perform marginal cost of service calculations are documented. (DLC)

31166 **(DOE/RG/10406—T7) Documentation of forecasting models for Chelan County PUD No. 1.** (Economic and Engineering Services, Inc., Bellevue, WA (USA)). Nov 1982. Contract FG01-80RG10406. 161p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE85012438.

This is a report on the estimation of the forecasting equations for the residential, commercial and industrial sectors of the Chelan County PUD No. 1 (District). This report also explores the use of univariate time series techniques (Box-Jenkins) for the forecasting of hourly system peak loads. The report presents the methodology to estimate new forecasting equations, but develops no actual forecasts. Heating and cooling degree days have been included to capture the seasonality inherent in electrical consumption.

31167 **(DOE/RG/10406—T9) Chelan County PUD No. 1 formal education services: topics B.7 and B.8.** (Economic and Engineering Services, Inc., Bellevue, WA (USA)). 17 Dec 1981. Contract FG01-80RG10406. 157p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE85012439.

This document includes notes on: rate of return for public utilities, wheeling rates, cogeneration, avoided cost of power, and management information systems.

31168 **(EPRI-EA—3934) Customer response to load management: a survey and analysis of utility studies. Final report.** Lawrence, A.G.; Baumgartner, R.M. (Angel Economic Reports, Cupertino, CA (USA); Heberlein-Baumgartner Research Services, Madison, WI (USA)). May 1985. 236p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920633.

Utility impacts from load management show great similarity if progam and demographic differences are taken into account. Data from 42 programs featuring direct load control or time-of-use rates offer utility analysis a basis for estimating load response to future efforts.

31169 **(EPRI-EA—3994) Sample design for load research: current practice and methods.** McCarthy, P.M.; Harris, L.R.; Kumar, B. (Applied Management Sciences, Inc., Silver Spring, MD (USA)). Apr 1985. 155p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920591.

Designing surveys that will give utilities accurate profiles of customer demand is difficult but new techniques are rapidly being developed to meet the challenge. This document reviews and summarizes the state of the art in selecting samples for study, focusing on how to deal with practical design problems.

31170 **(LUTMDN/TMVK—1006-1-32-(1983)) Electric load in single family houses. Load analysis and simulation studies for local mains.** Larsson, L. (Tekniska Hoegskolan, Lund (Sweden). Institutionen foer Vaerme- och Kraftteknik). Apr 1983. 157p. (In Swedish). NTIS (US Sales Only), PC A09/MF A01. File Number DE85750846.

This thesis deals with the study of electric loads in single family houses, presented as a composite dissertation with four major reports and a summary. The study is based upon data from a measurement project carried out in 1977 by the Energy Supply Board in Gothenburg. For each of 40 single family houses three load components were measured as average values for each quarter of an hour: 1) Electric load for water heating. 2) Electric space heating load. 3) Load of household appliances, lighting, etc. The analysis of data concerned the characteristics features of the long term average load, the average daily load, the maximum daily load, and the daily load curve. A computer simulation model was developed and proved to be well suited for simulations of the aggregate load from a group of single family houses with direct resistive electric heating, provided that the outdoor temperature is fairly constant. Load dimensioning recommendations for the local mains are discussed. The results from the study are also interpreted in the context of the contemporary Swedish energy policy.

31171 **(ORNL/TM—9509) Regulation, pricing, and comparative performance in the US electric utility industry by ownership type.** Hill, L.J.; Tepel, R.C. (Oak Ridge National Lab., TN (USA)). May 1985. Contract AC05-84OR21400. 155p. NTIS, PC A08/MF A01. File Number DE85012077.

Purpose of this report is to assess issues that differentiate investor-owned electric utilities and publicly owned electric utilities in the context of providing recommendations for modeling the US electric utility industry on the basis of ownership type. Four ownership types were included for evaluation: (1) investor-owned electric utilities; (2) state/municipal electric systems (which include municipally owned electric utilities, state and county projects, public utility districts, and joint action agencies); (3) rural electric cooperatives; and (4) federal power projects. Defining the publicly owned segment as the latter three ownership types, the basis of modeling recommendations was an evaluation of the regulation, pricing, associated financial/economic issues, and comparative performance of publicly and privately owned electric systems. The associated financial/economic issues include taxation, depreciation policy, sources of capital, capital structure, and the treatment of Construction Work in Progress. Performance by the four ownership types was compared over the 1979-1981 period. Areas of comparison include cost of capital, financial indicators, and operating results on a percentage of revenues and unit sales basis.

2980 Consumption And Utilization

REFER ALSO TO CITATION(S) 29781, 31152, 31159, 31191

31172 **(DOE/EIA—0035(85/02)) Monthly Energy Review, February 1985.** (USDOE Energy Information Administration, Washington, DC. Office of Energy Markets and End Use). May 1985. 126p. NTIS, PC A07/MF A01 - GPO; GPO Dep. File Number DE85012342.

Current data on US production, consumption stocks, imports, exports, and prices of principal energy commodities are reported for each month of 1983 through the most recent month of 1985, and for each year from 1973 through 1984. Quarterly summaries for the current year are also provided. Energy sources covered are crude oil, petroleum products, natural gas, coal, nuclear power, and electric utilities. Also reported are energy consumption by sector, selected energy indicators, and oil and gas resource development. For selected other countries in the world, production, consumption, and stocks of petroleum and electricity generation by nuclear power plants are presented. Conversion factors and a glossary are provided.

31173 **(DOE/EIA—0214(83)) State Energy Data Report: consumption estimates, 1960-1983.** (USDOE Energy Information Administration, Washington, DC. Office of Energy Markets and End Use). 23 May 1985. 688p. NTIS, PC A99/MF A01; 1 - GPO; GPO Dep. File Number DE85013310.

Estimates of US annual energy consumption are presented for each year from 1960 through 1983. Data are reported for the United States, each Census division, and each of the 50 States by major end-use sector and by principal energy type. Sectors are residential, commercial, industrial, transportation, and electric utilities. Energy types are coal, natural gas, petroleum, petroleum products, nuclear power, hydroelectric power, geothermal power, and wood/waste. Also included are: technical documentation describing how the estimates were made for each energy source, sources of all input data, and a summary of changes from the previous year's report.

31174 **(DOE/EIA—0214(83)S) State Energy Data Report Supplement: consumption estimates, 1960-1983.** (USDOE Energy Information Administration, Washington, DC. Office of Energy Markets and End Use). 23 May 1985. 96p. NTIS, PC A05/MF A01; 1 - GPO; GPO Dep. File Number DE85013047.

Estimated US and State energy consumption is presented for each year from 1960 through 1983. Summarized from the primary volume of this report are: energy consumption, per capita energy consumption, consumption by type (coal, natural gas, petroleum, nuclear power, and hydroelectric power), consumption by major end-use sector (residential, commercial, industrial, transportation, and electric utilities), and yearly changes in consumption. Complete technical documentation of the estimates is provided in the primary volume: "State Energy Data Report Consumption Estimates, 1960-1982" (DOE/EIA—0214(83)). 13 figs., 64 tabs.

31175 **(DOE/MI/10004—T1) Comparative effects of high energy cost on black and white families at four economic income levels.** Crumbly, I.J. (Fort Valley State Coll., GA (USA)). Dec 1983. Contract FG05-82MI10004. 94p. NTIS, PC A05/MF A01; GPO Dep. File Number DE85012544.

For both black and white families in Peach County and Fort Valley, Georgia, electrical energy consumption increased as the family income increased. White families consumed 23% more electrical energy than black families at the $23,500 income level. At the lowest income ($4500) level, black families consumed 55% more electrical energy than white families. Black families also used 5% more electrical energy than white families at both the $9,000 and $16,000 income levels. More electrical energy was consumed during the summer months than during the winter months. The greater consumption of electrical energy during the summer is associated with air conditioning. Although both black and white families consumed the greatest amount of gas energy at the highest income level, gas consumption was not as closely correlated with increase in income levels as electrical energy. For both black and white families, gas energy consumption was several times greater during the winter than during the summer months. In regards to the total cost of energy among black households, the $9000, $16,000 and $23,500 income levels spent 2%, 23% and 35% more money for the total cost of energy than the $4500 income level. Similarly, white households at the $9000, $16,000 and $23,500 income levels spent 33%, 30% and 101% more money for the total cost of energy, respectively, than the $4500 income level. One dollar out of every 6.4 dollars (or 15.6% of total income) was spent on energy at the $4500 income level in black households compared to one out of every 8.3 dollars (12.1% of total income) spent on energy at the same income level for white households. The lowest percentage of income spent on energy by black households was 4% at the $23,500 income level. For white families, the lowest percentage of income spent on energy was 4.4% at the $16,000 income level.

31176 **(NP—5770300) Thailand - energy situation 1983.** (Bundesstelle fuer Aussenhandelsinformation, Koeln (Germany, F.R.)). Mar 1985. 24p. (In German). NTIS (US Sales Only), PC A02/MF A01. File Number DE85770300.

Thailand's present energy situation is described with special regard to petroleum, natural gas, brown coal and alternative energy sources. .The main section contains tables on energy consumption, production, imports and consumption of petroleum and petroleum products, and electric power generation and consumption.

2990 Unconventional Sources And Power Generation

REFER ALSO TO CITATION(S) 30082, 30087, 30291, 30318, 30401, 30567, 31129, 31129

31177 **(CONF-8504134—1) Macro modeling of energy from agriculture.** Turhollow, A. (Oak Ridge National Lab., TN (USA)). Apr 1985. Contract AC05-84OR21400. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85011912.

From 26. Instrument Society of America modeling and simulation conference; Pittsburgh, PA, USA (25 Apr 1985).

Macro-level modeling of energy from agriculture has focused primarily on the production of ethanol from corn, with a few studies on the use of crop residues, oilseeds, and lignocellulosic crops. Both econometric simulation and mathematical programming models have been used. Some methods of improving these models are discussed. Research is now focusing on the use of lignocellulosic crops - agricultural and woody - and oilseeds dedicated to energy production. 19 refs., 2 tabs.

31178 **(DOE/ET/12016—4) Utah Geothermal Commercialization Project. Final report, April 1979-March 1985.** (Utah Div. of Water Rights, Salt Lake City (USA)). 1985. Contract FC07-79ID12016. 16p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85013311.

The Geothermal Commercialization Project is a cooperative program funded by the US Department of Energy and various individual states. Its purpose is to promote the utilization of geothermal energy through planning services, information dissemination, technical assistance, institutional analysis, and other support services. In Utah, the contracting agency is the Division of Water Rights of the Department of Natural Resources. The specific tasks which were performed in the course of the project included the identification and tabulation of known and potential resource sites; planning at the site-specific and regional levels; the analysis of institutional factors affecting the rate of progress of geothermal development; recommendations for improvement in state and federal regulatory procedures and policies; and continuous monitoring of geothermal activity in Utah. This report summarizes the results of these tasks and references the specific reports in which they can be found. The benefits of the project to the state are discussed, including the passage of state legislation dealing with the regulation of geothermal development in the state, and providing a source of information and assistance within the state for potential developers. Recommendations include additional legislation and continued support activity to facilitate the development of all types of geothermal resources in Utah.

31179 **(ERG-MR—3e) Renewable energy resources.** Lambert, Y.; Fall, D.; Isaza, J.F. (Energy Research Group, Ottawa (Canada)). Jul 1984. 54p. Energy Research Group, P.O. Box 8500, Ottawa K1G 3H9, Canada. File Number TI85901444.

This report contains 3 papers presented at the Energy Research Priorities Seminar held in Ottawa on August 8, 1983. The paper by Professor Lutz Hoffmann (Hoffmann 1984) outlined an approach to energy demand studies that involved the disaggregation of energy consumption to specific uses and the comparison of various technologies that could serve each use. Mr. Yves Lambert's paper is an application of this approach. It does not include the figures of consumption and costs that a Hoffmann-type study would require and to that extent it is difficult to test the validity of Lambert's conclusions. However, it is perhaps difficult to marshal such detailed data for West Africa. Professor Djibril Fall concentrates on some of the options, and reports on the work in progress in Senegal. Mr. Jose Fernando Isaza reports on the solar water heaters installed in Colombia. He stresses the extent of adaptive research and development (R and D) required, most of which was in system components other than the solar collectors. His paper perhaps carries a warning about over-specialization in energy research. Energy is an intermediate input, and improved energy technology will generally have to be fitted into products and equipment; some of it might, therefore, have better chances of success if it were undertaken by producers or institutions that do not narrowly specialize in energy. 3 refs., 10 figs., 14 tabs.

31180 **(ERG-MR—5e) Latin American research and development in the energy field: a review.** Torres, J.E. (Energy Research Group, Ottawa (Canada)). Aug 1984. 154p. Energy Research Group, Box 8500, Ottawa, Canada. File Number TI85901442.

This report is divided into six main sections. The first outlines the conceptual framework and methodology stressing the limitations that impede greater depth of analysis. The second, on the types and directions of research and development (R & D) activities in Latin America, is divided into three subsections, covering New and Renewable Sources of Energy (NRSE); conventional energy; and integrated energy resource R & D. In each subsection, the author endeavored to describe and critically assess R & D activities, achievements, and failures within the context of the limitations. Conclusions and recommendations in each case are implicitly or explicitly made depending on the field. In the third section, the state of science and technology (S-T) policy on energy resources is presented. The fifth section is a bibliography of 64 annotated and 52 unannotated items. Latin America as a whole has a solid R & D capability in the various energy fields, but with each country technically capable of intensifying efforts and obtaining results at least in a limited number of technologies. The human resource base as well as the physical infrastructure for intensified activity are either in place or readily within reach. Some countries, notably Argentina and Chile, may even have idle human and physical capacity for the level of activity they currently undertake. In general, the literature and interviews show that the potential contribution of R & D to the process of self-sustained development of Latin American society is large. Yet it is evident that the S-T systems of most countries have not responded in the past to the demands that the challenges of economic development and improvement of the quality of life of these societies impose upon them. It is evident that the primary cause has been twofold: the lack of articulation among the actors in the S-T system, and the dispersion of the few resources available.

31181 **(FRN-R—82-17) Renewable natural resources. A Swedish Research Programme for the Future.** Lundholm, B. (Swedish Council for Planning and Coordination of Research, Stockholm). 1982. 33p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85750833.

The report deals with the use of renewable natural resources and its effects on the environment and society. The main task is to consider the role of research in handling the problems of the future. To a large extent, the report reflects the opinions of Swedish scienific community.

30 DIRECT ENERGY CONVERSION

3001 Mhd Generators

REFER ALSO TO CITATION(S) 30656, 30657

31182 **(DOE-tr—273-Vol.1, pp IC9.1-IC9.12) Effects of cathode slag polarization on magnetohydrodynamic generator performance.** Petty, S.W. (Avco Everett Research Laboratory, Inc., Everett, MA). 1983. Translation source information not available . NTIS, PC A19/MF A01.

From 8. international conference on MHD electrical power generation; Moscow, USSR (12 Sep 1983).

In Eighth International Conference on MHD Electrical Power Generation. Vol. 1.

A series of experiments was conducted on a slagging magnetohydrodynamic (MGD) generator to investigate the loss in channel performance brought about by slag polarization phenomena in which large reductions in slag resistivity are observed on the cathode wall. A one meter long channel with 56 electrode pairs and peg type insulator walls was driven by an ash-injected, oil-fired combustor operating at 14 megawatt thermal input. At nominal channel operating conditions of 40 to 50 kWe and a Hall voltage of 500 to 800 volts there was a degradation in performance of approximately 10 percent in power and 30 percent in Hall voltage when the cathode wall slag was fully polarized. For newly slagged channel walls, the time required was between 80 and 100 minutes. Measurements of polarized Rosebud cathode slag conductivity ranged from 140 to 370 milliohms per meter yielding an equivalent channel slag conductivity of 70 to 90 milliohms per meter. By contrast, tests in which the seed was discontinued resulted in relatively no change in generated Hall voltage (approximately or equal to 500 volts) while power levels dropped to less than 1 kilowatt, demonstrating minimal leakage in the slag layer. It is concluded that the cathode slag layer is not continuous but is periodically broken. Shorting of Faraday currents in the presence of a Hall field results in increasing current concentrations at the downstream edge of the shorted group until sufficient joule heating is produced to locally remove or thin the slag layer and create an open insulator gap capable of sustaining the Hall voltage. The net effect was a resegmentation of the cathode wall from a design pitch of 1.5 centimeters to a pitch of between 4 and 10 centimeters depending on the iron oxide concentration in the ash. 5 refs., 11 figs., 3 tabs.

31183 (**DOE-tr—273-Vol.1,** pp IB5.1-IB5.10) **Magnetohydrodynamic generator performance comparisons between coal and oil plus ash firing.** Enos, G.; Kessler, R.; Petty, S.; Swallom, D. (Avco Everett Research Laboratory, Inc.). 1983. Translation source information not available . NTIS, PC A19/MF A01. Contract AC22-80ET15614.

From 8. international conference on MHD electrical power generation; Moscow, USSR (12 Sep 1983).

In Eighth International Conference on MHD Electrical Power Generation. Vol. 1.

A two stage slagging coal combustor developed by the Thomson Ramo Williams (TRW) Corporation, was successfully integrated with a magnetohydrodynamic (MGD) generator developed by the Avco Corporation, when the two companies cooperated in an operational demonstration of a coal fired magnetohydrodynamic power train under the sponsorship of the Department of Energy (DOE). The experimental components, rated at a nominal 20 megawatt thermal input, are the engineering prototypes of a 50 thermal megawatt hardware to be supplied by the contractors to the recently commissioned Component Development and Integration Facility (CDIF), a federal magnetohydrodynamic test site in Butte, Montana. A second series of tests was conducted in which the same channel and operating parameters were employed with an oil fired ash injected combustor (AIC) to provide performance comparisons. The primary objective was the validation of using an ash injected combustor for development of coal fired magnetohydrodynamic generators. The only significant performance variation uncovered in the comparison tests was attributable to a less than optimum method and location for seed injection in the coal fired combustor. The corrective measures are deemed to be relatively straightforward. 11 figs.

31184 (**DOE-tr—273-Vol.1,** pp IC1.1-IC1.6) **The effect of current control circuits on magnetohydrodynamic generator performance.** Demirjian, A.M.; Hruby, V.J.; Pian, C.C.P.; Quijano, I.M. (Avco Everett Research Laboratory, Inc., Everett, Massachusetts). 1983. Translation source information not available . NTIS, PC A19/MF A01. Contract AC22-80ET15614.

From 8. international conference on MHD electrical power generation; Moscow, USSR (12 Sep 1983).

In Eighth International Conference on MHD Electrical Power Generation. Vol. 1.

Coal fired magnetohydrodynamic (MGD) generators may be required to operate with molten slag flow on their walls. Experimental investigation has shown that the Hall voltage of the generator is sustained nonuniformly among the segments of the cathode wall. This is demonstrated by the step ladder pattern of the axial Hall voltage distribution among the generator cathodes, obtained from the operation of the AERL Mark Six Faraday generators under typical coal combustion environments. Groups of cathodes shorted by slag are bordered by high voltage gaps. No deleterious effects have been observed by such nonuniformities in a Faraday generator. However, they are found to cause severe spatial current fluctuations in the diagonal generator. This results in increased electrical stresses on a few electrodes which may ultimately lead to their early failure. Forced current sharing among electrodes, effected by current controllers, is of primary importance for the long duration operation of diagonal generators. In this paper the control of diagonally connected magnetohydrodynamic generators is investigated. Special circuits that were developed for this purpose are described. In addition to securing the uniformity of electrode current distribution in a slagging channel, these circuits decouple the electrode walls of the generator and eliminate the damage to the anode caused by cathode wall nonuniformities. The implication of current control circuits on a large scale magnetohydrodynamic generator is discussed next and the results of design studies and performance predictions are presented. Continuous window frame diagonal generators are not discussed because to date, no feasible methods of controlling current flows in the frames that are part of the channel structure exist. 2 refs., 9 figs., 3 tabs.

31185 (**DOE-tr—273-Vol.1,** pp ID10.1-ID10.9) **Analytical investigations of the effects of cathode nonuniformities on magnetohydrodynamic (MGD) generator characteristics.** Pian, C.C.P.; McClaine, A.W.; Sadovnik, I. (Avco Everett Research Laboratory, Inc., Everett, MA). 1983. Translation source information not available . NTIS, PC A19/MF A01. Contract AC22-80ET15614.

From 8. international conference on MHD electrical power generation; Moscow, USSR (12 Sep 1983).

In Eighth International Conference on MHD Electrical Power Generation. Vol. 1.

The effects of cathode wall nonuniformities caused by slag shorting on the internal electrical characteristics of Faraday loaded generators are investigated analytically. Two analytical models are utilized in the investigation: a three dimensional finite element electrical model and a two dimensional current stream function solver. The cathode nonuniformities are treated in these models as a coarser resegmentation of the cathode wall. These models are described and some results based on the models are presented. Model assumptions which are critical to obtaining proper results are identified. 13 refs., 11 figs.

3003 Thermoelectric Generators

REFER ALSO TO CITATION(S) 31523

3004 Thermionic Converters

REFER ALSO TO CITATION(S) 30752

3005 Fuel Cells

31186 (**CONF-850311—14-Draft**) **Thermodynamics of the corrosion of chromium in molten carbonates.** Hsu, H.S.; DeVan, J.H. (Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 24p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85011407.

From National Association of Corrosion Engineers annual meeting and materials performance and corrosion show; Boston, MA, USA (25 Mar 1985).

To define and study the mechanisms that control the corrosion of current collector materials in molten carbonate fuel cells (MCFC), the corrosion of chromium in Li_2CO_3-K_2CO_3 has been investigated from a thermodynamic point of view. Thermochemical calculations with the SOLGASMIX-PV computer program were used to establish equilibrium phase relationships. This paper considers phase stability diagrams of Cr-Li_2CO_3, Cr-K_2CO_3, and Cr-$(Li,K)_2CO_3$ systems at 650°C. The condensed phases at equilibrium are mapped as functions of log a/sub O_2/ and log a/sub CO_2/ for the gas mixture O_2, CO_2, and Ar at 1.0 atm (1.01×10^5 Pa) total pressure; where a/sub O_2/ and a/sub CO_2/ are the activities (partial pressures) of O_2 and CO_2, respectively. In the system Cr-$(Li,K)_2CO_3$, a mixture of $(Li,K)_2CO_3$ and $(Li,K)_2CrO_4$ should exist under oxidizing environments when log a/sub O_2/ > -5.0 and log a/sub CO_2/ > -4.6, and a mixture $(Li,K)_2CO_3$ and $LiCrO_2$ is stable in reducing atmospheres when log a/sub O_2/ < -8.0 and log a/sub CO_2/ > -4.6. The concentration of $(Li,K)_2CrO_4$ is dependent on the concentration of $(Li,K)_2CO_3$. The ternary phase boundary of $(Li,K)_2CO_3$-$(Li,K)_2CrO_4$-$LiCrO_2$ varies when the concentration of $(Li,K)_2CO_3$ changes. These predicted phase relationships were checked experimentally by thermogravimetric analysis (TGA) and differential thermal analysis (DTA). The results of TGA and DTA were self-consistent with respect to the reaction products from the calculated phase stability diagrams. 14 refs., 8 figs., 2 tabs.

31187 (**N—85-16292**) **Engineering model system study for a regenerative fuel cell: study report.** Chang, B.J.; Schubert, F.H.; Kovach, A.J.; Wynveen, R.A. (Life Systems, Inc., Cleveland, OH (USA)). Sep 1984. 91p. (NASA-CR—174801). NTIS, PC A05/MF A01.

Key design issues of the regenerative fuel cell system concept were studied and a design definition of an alkaline electrolyte based engineering model system or low Earth orbit missions was completed. Definition of key design issues for a regenerative fuel cell system include gaseous reactant storage, shared heat exchangers and high pressure pumps. A power flow diagram for the 75 kW initial space station and the impact of different regenerative fuel cell modular sizes on the total 5 year to orbit weight and volume are determined. System characteristics, an isometric drawing, component sizes and mass and energy balances are determined for the 10 kW engineering model system. An open loop regenerative fuel cell concept is considered for integration of the energy storage system with the life support system of the space station. Technical problems and their solutions, pacing technologies and required developments and demonstrations for the regenerative fuel cell system are defined.

31188 (NP—5770191, pp 6.1-6.52) **Fuel cells and batteries in the future Danish energy system.** Jensen, J. (Odense Universitet, Denmark. Lab. for Energiforskning). Jan 1984. (In Danish). NTIS (US Sales Only), PC A16/MF A01. File Number DE85770191.

EFP-81.

In Technological development and its impact on the future energy system. Appendix 1. Evaluation commissioned by the Danish Ministry of Energy.

About year 2000 there can be expected solved some technical problems and fuel cells and batteries can be incorporated into the Danish power system. Probably first in 2030 the economic basis will be sound enough to develop large scale electrochemical storage- and conversion units.

31189 **Adsorption of trifluoromethanesulfonate anions at the mercury/electrolyte interface.** Gonzalez, E.R.; Srinivasan, S. (Los Alamos National Lab., NM). *Electrochimica Acta;* **27**: No. 10, 1425-1428(1982).

Recently, there has been much interest in the use of trifluoromethanesulfonic acid as an electrolyte in advanced fuel cell systems because of the enhanced rate of oxygen reduction in this medium. In order to elucidate this characteristic from a double layer point of view, the present work was undertaken to study the adsorption of trifluoromethanesulfonate ions on mercury electrodes. Differential capacities and potentials of zero charge were measured in constant ionic strength solutions at 25°C. Analysis of the results shows that the extent of specific adsorption of $CF_3SO_3^-$ anions is small, and the anions even desorb from the surface at sufficiently positive electrode charges. The structure of the inner layer is elucidated, and an isotherm for the adsorption of $CF_3SO_3^-$ based on electrostatic models of the double layer is derived. The results indicate that at the potentials for the electroreduction of oxygen $CF_3SO_3^-$ anions will not interfere with the adsorption of the reactant and of intermediates, allowing faster rates to be achieved.

32 ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

31190 (CONF-8505146—1) **Intra-organizational environment of technological change: insights from the Navy's Energy Program.** Brown, M.A.; Jones, D.W. (Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 35p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85012902.

From Southern Regional Science Association meeting; Washington, DC, USA (9 May 1985).

In a case study of the adoption of energy-conserving technologies and behaviors at Naval shore facilities in the Southeastern United States, the internal organizational environment was found to exert as great an influence on investment decisions as market prices and apparent savings opportunities. This paper discusses relevant segments of the Navy's organizational environment and the behavior of decision makers within it. Results of site visits and a survey of decision makers at Naval shore facilities suggest that the most significant barrier to adoption of new energy-conserving technology is a shortage of personnel to install, operate, and maintain new equipment. This situation enforces energy use patterns which may appear excessive, but which may be appropriate choices when guided by conditions of local manpower scarcities combined with the ability to draw on additional funds to cover unpaid fuel bills. A contributing problem is that only a small proportion of energy consumption activities are metered and many existing meters go unread. The inability to identify excessive energy users and to verify energy savings inhibits effective modifications of behavioral patterns and the introduction of new equipment. We consider the implications of these findings for the technological change activities of other public and private organizations with multi-locational structures, in which internal "shadow markets" are important. 24 refs., 3 figs., 1 tab.

31191 (PNL—5462) **Project on Restaurant Energy Performance: end-use monitoring and analysis.** Claar, C.N.; Mazzucchi, R.P.; Heidell, J.A. (Pacific Northwest Labs., Richland, WA (USA)). May 1985. Contract AC06-76RL01830. 154p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE85013167.

Although energy bills for restaurants throughout the United States exceed 5 billion dollars annually, very little has been documented with respect to when and how restaurants use energy, or how such use can be reduced cost-effectively. This report summarizes the results of a multiyear collaborative research effort, designed to collect information on end-use energy consumption. Objective is to reveal the quantities and profiles of energy consumption of typical food service operations by time of day and end use. This information, when examined in conjunction with building characteristics, allows detailed study of energy use cause and effect and energy conservation potential. Seven representative monitoring sites were selected, a computerized data acquisition network was designed and implemented, and detailed energy performance was compiled for a 1 year period (July 1983 through June 1984). Each of the seven facilities monitored was selected to represent the seven most common restaurant types and to provide information on a wide variety of commonly used restaurant equipment. Preliminary findings are presented.

3201 Buildings

REFER ALSO TO CITATION(S) 30085, 30285, 30286, 30287, 30288, 30289, 30357, 30360, 30372, 30377, 30404, 30405, 30406, 30407, 30409, 30412, 30414, 30415, 30416, 30417, 30418, 30419, 30420, 30421, 30422, 30423, 30424, 30425, 30426, 30427, 30428, 30429, 30431, 30432, 30433, 30434, 30437, 30438, 30439, 30439, 30440, 30441, 30442, 30443, 30444, 30445, 30447, 30451, 30453, 30454, 30456, 30457, 30458, 30459, 30460, 30463, 30464, 30464, 30465, 30466, 30467, 30469, 30470, 30471, 30473, 30479, 30481, 30482, 30484, 30485, 30486, 30489, 30492, 30495, 30504, 30505, 30509, 30510, 30513, 30514, 30515, 30518, 30524, 30526, 30527, 30529, 30531, 30535, 30540, 30554, 30555, 30558, 30559, 31170, 31362, 32123

31192 (AD-A—151707/7/XAB) **Automated building design review using BLAST (Building Loads Analysis and System Thermodynamics). Final report.** Amber, J.; Leverenz, D.J.; Herron, D.L. (Army Construction Engineering Research Lab., Champaign, IL (USA)). Jan 1985. 45p. (CERL-TR-E—85/03). NTIS, PC A03/MF A01.

Supersedes Rept. no. CERL-TR-E-190, AD-A134 487.

This document describes a method for using the Building Loads Analysis and System Thermodynamics (BLAST) energy-simulation computer program to review the energy effectiveness of the new Army facility designs. This review method covers both aspects of new Army's energy criteria: prescriptive energy standards and facility energy-design budgets. The method compares the energy-criteria with information contained in a BLAST output deck. This deck contains most of the information needed to review a new design for compliance with energy criteria. A special BLAST Design Review Summary Report was developed which provides, in an easy-to-read, standard format, the information needed to check a design for energy criteria compliance. A description of the prototype design review procedure was published in USA-CERL TR-E-190. The review procedure and the Review Summary Report were modified based on the results of field tests. The modifications, which are presented in this report, further enhance the procedure's utility by providing the user with more information about the building design, making the Review Summary Report more of a stand-alone document. This report describes how Army Corps of Engineers Districts can use the BLAST Review Summary Report to review the energy effectiveness of new facility designs submitted by architect/engineer firms who use BLAST.

31193 (AD-A—151708/5/XAB) **New control design principles based on measured performance and energy analysis of HVAC (heating, ventilating, and air-conditioning) systems. Interim report.** Hittle, D.C.; Johnson, D.L. (Army Construction Engineering Research Lab., Champaign, IL (USA)). Jan 1985. 46p. (CERL-IR-E—85/02). NTIS, PC A03/MF A01.

This report is one of a series on the development of heating, ventilating, and air-conditioning (HVAC) control systems that are simple, efficient, reliable, maintainable, and well-documented. This report identifies major problems associated with three currently used HVAC control systems. It also describes the development of a retrofit control system applicable to military buildings that will allow easy identification of component failures, facilitate repair, and minimize system failures. Evaluation of currently used controls showed that pneumatic temperature control equipment requires a very clean source of supply air and is also not very accurate. Pneumatic, rather than electronic, actuators should be used because they are cheaper and require less maintenance. Thermistor temperature detectors should not be used for HVAC applications because they require frequent calibration. It was found that enthalpy economy cycles cannot be used for control because the humidity sensors required for their use are prone to rapid drift, inaccurate, and hard to calibrate in the field. Performance of control systems greatly affects HVAC operating costs. Significant savings can be achieved if proportional-plus-integral control schemes are used. Use of the retrofit prototype control panel developed in this study on variable-air-volume systems should provide significant energy cost savings, improve comfort and reliability, and reduce maintenance costs.

31194 (ASHRAE/SP—28, pp 9-14) **Calculator programming technique for estimating thermally optimum wall construction.** Twenty, J.E.; McQueen, L.V. (Energy Management and Control Corp., Topeka, KS). 1981. NTIS, PC A99/MF A01. File Number DE83014620. (CONF-791233—).

From Conference on thermal performance of the exterior envelopes of buildings; Orlando, FL, USA (3 Dec 1979).

Models suitable for programmable calculators were developed for predicting building thermal envelope mechanical systems interactions and their affect on energy consumption. The models were based on the bin method. The models include single zone air conditioning systems, multizone and dual duct systems, variable air volume systems, and heat pump systems.

31195 (ASHRAE/SP—28, pp 33-51) **Simple methods for predicting thermal behavior and energy consumption in buildings.** Agnoletto, L.; Brunello, P.; Zecchin, R. (Universita di Padova, Italy). 1981. NTIS, PC A99/MF A01. File Number DE83014620. (CONF-791233—).

From Conference on thermal performance of the exterior envelopes of buildings; Orlando, FL, USA (3 Dec 1979).

Algorithms for the evaluation of energy needs for the heating and cooling of buildings are presented which are suitable for pocket and desk-top calculator use. The algorithms were developed from more complex models developed for computer use and give good agreement with those models.

31196 (ASHRAE/SP—28, pp 52-57) **Energy conservation design guidelines for including mass and insulation in building walls.** Dexter, M.E. (Syska and Hennessy, Inc., New York, NY). 1981. NTIS, PC A99/MF A01. File Number DE83014620. (CONF-791233—).

From Conference on thermal performance of the exterior envelopes of buildings; Orlando, FL, USA (3 Dec 1979).

In the design of energy efficient buildings, it is necessary to optimize wall insulation and thermal mass. The benefits of insulation in light-weight walls are well understood. However, the effects of mass for energy conservation are grossly overestimated by many while being completely neglected by others. Insulation and mass can be combined in different ways to achieve different results as desired in heating, heating/cooling, and cooling climates. Special consideration must be given to internal loads and occupancy profiles (daytime only vs. 24 hour occupancy) and how the walls can help reduce building loads rather than impose building loads. Guidelines are presented here for applying mass and insulation for energy conserving wall design.

31197 (ASHRAE/SP—28, pp 85-93) **Use of sound to locate infiltration openings in buildings.** Keast, D.N.; Pei, H.S. (Bolt Beranek and Newman Inc., Cambridge, MA). 1981. NTIS, PC A99/MF A01. File Number DE83014620. (CONF-791233—).

From Conference on thermal performance of the exterior envelopes of buildings; Orlando, FL, USA (3 Dec 1979).

Sound waves pass readily through many of the same openings in building envelopes that allow air infiltration. This fact permits the location of such air-infiltration openings by acoustic means. The results of an experimental program, including laboratory tests of a specially constructed partition and field tests on eight buildings, are reported. On the average, openings that can be located acoustically transmit sound that is about twice as loud as that through adjacent, sealed locations. Laboratory studies indicate that the sound level increase through a leakage opening is roughly correlated with the logarithm of the local air flow rate when a steady differential pressure is established across the partition ($r = 0.67$). Leak location with sound can be done by semiskilled workers with low cost hi-fi shop equipment. The test procedure does not require pressure or temperature differentials across the building envelope.

31198 (ASHRAE/SP—28, pp 94-121) **Low pressure leakage function of a building.** Sherman, M.H.; Grimsrud, D.T.; Sonderegger, R.C. (Lawrence Berkeley Lab., CA). 1981. NTIS, PC A99/MF A01. File Number DE83014620. (CONF-791233—).

From Conference on thermal performance of the exterior envelopes of buildings; Orlando, FL, USA (3 Dec 1979).

A new technique for measuring low-pressure leakage of a building is presented, based on AC pressurization. In this technique the volume of the building is modulated with a given frequency using a cylinder and piston assembly sealed into a door or window. By contrast the conventional DC pressurization technique measures the flow necessary to keep a given steady state pressure difference across the envelope. By measuring the interior pressure response synchronously to the volume oscillation AC pressurization can eliminate the pressure fluctuations caused by the weather, that make DC measurements difficult in the low-pressure range. Many models have been devised to correlate air infiltration in buildings with weather parameters. A particularly promising strategy is to predict the air flow through the building envelope from surface pressures, which in turn are predicted from measured weather parameters. Due to weather induced noise, it is difficult to measure the pressure-flow relationship in a manner that is valid for the low surface pressures which have been observed to drive infiltration. Conventional techniques rely on steady-state (DC) fan pressurization or depressurization of the structure. DC-measurements are unreliable at pressures less than 5-10 Pa, yet this is the pressure range that often drives natural infiltration. This paper reports measurements of the leakage function measured at low-pressures using an alternating (AC) pressure source with variable frequency and displacement. Synchronous detection of the indoor pressure signal created by the source eliminates the noise due to fluctuations caused by the wind. Comparisons are presented between these results and extrapolations of direct fan leakage measurements.

31199 (ASHRAE/SP—28, pp 221-236) **Laboratory tests of thermal performance of exterior walls.** Fiorato, A.E. (Construction Technology Labs., Skokie, IL). 1981. NTIS, PC A99/MF A01. File Number DE83014620. (CONF-791233—).

From Conference on thermal performance of the exterior envelopes of buildings; Orlando, FL, USA (3 Dec 1979).

The Construction Technology Laboratories calibrated hot box test facility to evaluate steady-state and dynamic thermal performance of wall assemblies is described. This facility consists of two highly insulated environmental chambers that enclose the test wall. Nominal overall dimensions of the test wall are 103 x 103 in. (2.62 x 2.62 m). Wall thicknesses can be varied. The facility was designed to accommodate test walls with thermal resistance values ranging from 1.5 to 20 hr x ft^2 x F/Btu (0.26 to 3.52 k x m^2/W). One of the insulated chambers simulates an indoor environment and is maintained at a constant room temperature between 65 and 80 F (18 and 27 C). The other chamber simulates an outdoor environment where temperatures are held constant or cycled between -20 and 120 F (-29 and 49 C). Instrumentation is provided to monitor air and surface temperatures on each side of the test wall, and energy required to maintain constant indoor temperature. Examples of steady-state and dynamic test procedures and results are given. Steady-state tests are used to obtain heat transmission coefficients such as thermal conductance (C) and resistance (R). Dynamic tests provide quantitative data on thermal response that include effects of thermal storage capacity as well as thermal resistance of wall assemblies.

31200 (ASHRAE/SP—28, pp 237-249) **Calibration procedures and results for a large calibrated hot box.** Rucker, J.L.; Mumaw, J.R. (Owens-Corning Fiberglass, Granville, OH). 1981. NTIS, PC A99/MF A01. File Number DE83014620. (CONF-791233—).

From Conference on thermal performance of the exterior envelopes of buildings; Orlando, FL, USA (3 Dec 1979).

This paper describes the evolution of the Owens-Corning Fiberglas Large Scale Horizontal Calibrated Hot Box known as the Thermal Research Facility described previously at the joint DOE/ASTM Insulation Conference in Tampa, Florida, 1978. The facility was constructed for experimental measurements of thermal performance of large composite horizontal building elements, as well as total building envelopes such as a one-room structure or a mobile home. This discussion summarizes the original design concepts, reviews the limitations involved with these concepts, and details the final hot box configuration. The discussion includes a detailed analysis of the limitations, with regard to power measurements and stabilization and the solutions incorporated into the final design to overcome these operational limitations. The total conditioning and measurements systems including the heating and cooling systems, the instrumentation, power measurements equipment, and data acquisition and analysis systems involved with the facility in its final design are described. The comprehensive calibration test program and the summary of results obtained are presented. The physical significance of the experimental results are explained by comparison to the mathematical model of the overall system. Details of the calibration sample used in the program are discussed also. The paper concludes with recommendations for calibration procedures for future facilities of this type.

31201 (ASHRAE/SP—28, pp 269-282) **Thermal insulation laboratory accreditation program.** Bryson, J.O. (National Bureau of Standards, Washington, DC). 1981. NTIS, PC A99/MF A01. File Number DE83014620. (CONF-791233—).

From Conference on thermal performance of the exterior envelopes of buildings; Orlando, FL, USA (3 Dec 1979).

Laboratory accreditation has emerged because US commerce has a strong interest in ensuring that laboratory test results are accurate, useful, and obtained in an efficient manner. Criteria for accrediting laboratories that test thermal insulation materials were published in the Federal Register on January 28, 1979. Inspection and evaluation procedures have been carried out in thirty testing laboratories which constitute the first group evaluated for accreditation under the National Voluntary Laboratory Accreditation Program (NVLAP). NVLAP is a system developed within the Department of Commerce in cooperation with the private sector to examine, upon request, the professional and technical competence of private public testing laboratories. The program is intended to accredit laboratories that meet certain general and specific criteria germane to their technological testing service. An ov,erview of the accreditation process and the experience gained in evaluating the laboratories is presented.

31202 (ASHRAE/SP—28, pp 283-298) **Thermal parameters as a function of thickness for combined radiation and conduction heat transfer in low-density insulation.** Rennex, B.G. (National Bureau of Standards, Washington, DC). 1981. NTIS, PC A99/MF A01. File Number DE83014620. (CONF-791233—).

From Conference on thermal performance of the exterior envelopes of buildings; Orlando, FL, USA (3 Dec 1979).

Approximate expressions are obtained for the apparent thermal conductivity and thermal resistance, in the case of combined conductive and radiative heat transfer through low-density insulation. These expressions are obtained in the regimes of intermediate and large optical depth, and they depend on only two parameters to be determined by experiment, namely the conduction thermal conductivity, k/sub c/, and the extinction coefficient, β. An expression is obtained for the apparent thermal resistance of an insulation consisting of layers with distinct densities. The applicability of these expressions to the interpretation of experimental results and to the improvement of ASTM Test Methods is discussed.

31203 (ASHRAE/SP—28, pp 299-307) **Design and construction of a calibrated/guarded hot box facility.** Perrine, E.L.; Linehan, P.W.; Howanski, J.W.; Shu, L.S. (Wiss, Janney, Elstner and Associates, Northbrook, IL). 1981. NTIS, PC A99/MF A01. File Number DE83014620. (CONF-791233—).

From Conference on thermal performance of the exterior envelopes of buildings; Orlando, FL, USA (3 Dec 1979).

A complete Calibrated/Guarded Hot Box test facility was fabricated by Wiss, Janney, Elstner and Associates for the Construction Products Division of W.R. Grace & Company. The facility essentially consists of two environmental chambers, one calibrated chamber, one metering chamber, a control and data acquisition system including a HP9835-A mini-computer, a drying oven, a preconditioning chamber, insulated test frames and a pneumatic transport system. The facility allows specimens to be tested horizontally or vertically, under steady state or dynamic temperature conditions. Design specifications are presented.

31204 (ASHRAE/SP—28, pp 308-324) **Design of a calibrated hot-box for measuring the heat, air, and moisture transfer of composite building walls.** Achenbach, P.R. (National Bureau of Standards, Washington, DC). 1981. NTIS, PC A99/MF A01. File Number DE83014620. (CONF-791233—).

From Conference on thermal performance of the exterior envelopes of buildings; Orlando, FL, USA (3 Dec 1979).

A large calibrated hot-box is to be constructed at the National Bureau of Standards to support the development of standard procedures for measuring the heat, air and moisture transfer of room-size (3.0 by 4.5 m) exterior-wall specimens under a range of simulated climatic conditions. The apparatus will be used for research in both steady-state and dynamic thermal performance in support of standard test methods; for study of the processes of heat transfer, air leakage and moisture transfer in building walls as aids to the design and construction of buildings for energy conservation; and to provide traceability in measurement to NBS through calibration services, Standard Reference Materials or the National Voluntary Laboratory Accreditation Program. The facility is being designed, constructed and operated under the joint sponsorship of the Department of Energy and the National Bureau of Standards as part of the National Program Plan for Building Thermal Envelope Systems and Insulating Materials, issued by the Department of Energy in January 1979.

31205 (ASHRAE/SP—28, pp 327-346) **Effective U-values for skylights.** Burkhardt, W.C. (Skylight Industries Inc., Independence, MO). 1981. NTIS, PC A99/MF A01. File Number DE83014620. (CONF-791233—).

From Conference on thermal performance of the exterior envelopes of buildings; Orlando, FL, USA (3 Dec 1979).

Increased interest in energy conservation, codes, and costs has prompted us to publish curves of effective U-values for skylights. Conventional U-values are used by architects and engineers to estimate heating and cooling loads of buildings. An estimate of these loads is necessary in order to properly size heating and air-conditioning equipment. Conventional U-values work well for this purpose. However, for energy computational purposes it does not work well especially for building elements that transmit light (like a skylight - for example). The reason being is that solar gain and daylighting advantages are not taken into account in establishing conventional U-values. Hence, we developed effective U-values which give a fairly good representation of the annual net energy balance through skylights.

31206 (ASHRAE/SP—28, pp 347-353) **Dynamic interpane systems for multipane solar collector windows.** Berlad, A.L. (State Univ. of New York, Stony Brook). 1981. NTIS, PC A99/MF A01. File Number DE83014620. (CONF-791233—).

From Conference on thermal performance of the exterior envelopes of buildings; Orlando, FL, USA (3 Dec 1979).

It has been shown previously that for twin-pane windows, a variety of interpane blinds and/or other interpane structures can be employed to suppress natural convective and unwanted (infrared) radiative heat losses from a wintertime conditioned space to its cold exterior. For previously reported systems, effective R-values greater than 1.06m$^{2\circ}$ C/W (or 6[Btu/hr x ft$^{2\circ}$F]$^{-1}$) have been measured for solar acceptance mode operation and R-values greater than 1.76m$^{2\circ}$ C/W (or 10[Btu/hr x ft$^{2\circ}$F]$^{-1}$) have been measured for nighttime mode operation. New dynamic interpane systems have been investigated which utilize previously considered methods as well as forced convective flows, together with principles of regenerative heat exchange to suppress further the undesirable heat losses from a conditioned space. Design principles for such windows are discussed.

31207 (ASHRAE/SP—28, pp 411-420) **Extension of methods used in analyzing building thermal loads.** Cumali, Z.O.; Sezgen, A.O.; Sullivan, R.; Kammerud, R.C. (Consultants Computation Bureau/Cumali Associates, Oakland, CA). 1981. NTIS, PC A99/MF A01. File Number DE83014620. (CONF-791233—).

From Conference on thermal performance of the exterior envelopes of buildings; Orlando, FL, USA (3 Dec 1979).

This paper details analytical procedures for use in building thermal loads analysis and modeling. The first technique discussed details the mathematical basis of a recursion relationship developed to define building/space weighting factors. The weighting factors generated encompass radiative and conductive heat gain and space air temperature fluctuations. To preclude the use of weighting factors, an additional technique is presented which makes possible the calculation of either a pseudo or real surface temperature; thus, space loads can be ascertained directly. Finally, the third procedure relates the frequency of specific input excitations to overall building response and/or energy consumption; this is primarily a procedural technique for simplifying the analysis and selection of architectural alternatives.

31208 (ASHRAE/SP—28, pp 421-435) **Heat transmission coefficients of concrete block walls with core insulation.** Shu, L.S.; Fiorato, A.E.; Howanski, J.W. (W.R. Grace and Co., Cambridge, MA). 1981. NTIS, PC A99/MF A01. File Number DE83014620. (CONF-791233—).

From Conference on thermal performance of the exterior envelopes of buildings; Orlando, FL, USA (3 Dec 1979).

An investigation of heat transmission coefficients of 8-in. concrete block walls with and without core insulation is described. Measured average thermal conductance (C) and transmittance (U) values were obtained from Guarded Hot Box Tests (ASTM Designation: C236). They were compared with values calculated in accordance with current design practice. Test results differed considerably from design values. This was attributed to the following factors: (1) The thermal conductivity of a core insulation material is not the sole factor in the overall thermal performance of a masonry wall. The ability of the core insulation to fill all voids in the wall is also important. (2) Design thermal conductivities do not represent in situ material properties. (3) Design calculations of heat transmission coefficients do not reflect multi-dimensional heat flow conditions. Closer estimates of transmittance were calculated using measured rather than design conductivity values. However, it is recommended that measured U-values be used as a primary basis for the design of wall assemblies.

31209 (ASHRAE/SP—28, pp 472-490) **Technical review of the M factor concept.** Godfrey, R.D.; Wilkes, K.E.; Lavine, A.G. (Owens-Corning Fiberglas, Granville, OH). 1981. NTIS, PC A99/MF A01. File Number DE83014620. (CONF-791233—).

From Conference on thermal performance of the exterior envelopes of buildings; Orlando, FL, USA (3 Dec 1979).

There is no question that massiveness of building envelopes affects instantaneous heat transmission through them under transient conditions. In an attempt to include these affects in ASHRAE Standard 90-75 calculations, masonry interests have developed a concept known as the M Factor. It has been proposed that the steady state conduction equation specified in 90-75 be modified by a multiplying factor (M Factor) to account for massiveness of the envelope. These factors were calculated by forming the ratio of dynamic heat flux to that predict by steady state methodology. Ratios were calculated for eight (8) orientations at 8 a.m. for a typical day in January and then averaged. Ten (10) wall types were considered in ten (10) cities in various climatic regions. These ratios are presented graphically as M Factor versus degree days for various wall masses. Although the simplicity of this approach is attractive, consideration of the definition raises serious questions about the technical validity. Most troublesome is implying seasonal energy performance based on a ratio calculated for one hour out of an entire year. Averaging the effect of exposures is also questionable. This paper will address the question of the significance of using one hour per year to characterize seasonal energy performance. Daily and seasonal heat fluxes are calculated using both dynamic and steady state procedures. Typical weather data are utilized. A broad range of wall characteristics are investigated including thermal resistance, massiveness, and placement of mass within the wall. These results are compared to those calculated for an average day in January at 8 a.m. In addition, the effects of interaction of internal partitions with exterior walls are discussed.

31210 (ASHRAE/SP—28, pp 508-521) **Statistical decision method for economic evaluation of the exterior envelopes of buildings.** Ercules, A.M. (FIAT Engineering Torino, Italy). 1981. NTIS, PC A99/MF A01. File Number DE83014620. (CONF-791233—).

From Conference on thermal performance of the exterior envelopes of buildings; Orlando, FL, USA (3 Dec 1979).

The author describes a multi-stage adaptive statistical decision method which can help to define standards for the insulation of the exterior envelopes of buildings. Two types of uncertainty are explored. The first type involves possible changes in economical and competitive factors likely to affect cash flows. These factors will be referred to as states of the world. The second type involves the uncertainty of cash flows, once the states of the world are known. The method, based on Bayesian theory, is primarily concerned with the first uncertainty type. The decision maker is allowed to take differences in the time of future earnings into account, by the use of a discount rate. His attitudes towards risk and non-monetary utilities associated with the possible outcomes are considered in the decision procedure. As an example it is shown how, in a real-world case, the proposed method can lead to results that are substantially better than the ones obtained by more conventional techniques.

31211 (ASHRAE/SP—28, pp 587-594) **Energy conservation opportunities in the building envelope through the enforcement of a mandatory energy code.** Miller, D.R. (Massachusetts Building Code Commission, Boston). 1981. NTIS, PC A99/MF A01. File Number DE83014620. (CONF-791233—).

From Conference on thermal performance of the exterior envelopes of buildings; Orlando, FL, USA (3 Dec 1979).

The Massachusetts State Building Code has included energy conservation provisions based on ASHRAE Standard 90 for the building envelope and mechanical/electrical systems since January, 1978. As part of its programmatic review the Building Code Commission has been monitoring the implementation of these energy conservation regulations via a plan review service for all non-residential buildings. Since the Commission staff reviews a large portion of new construction building designs, the service provides a vehicle to maintain close contact with both the design and code enforcement communities, but more significant is that it provides a check on the level of energy conservation designed into today's buildings. The results of this monitoring activity are startling as the staff of the Commission gains insight to the state-of-the-art in energy efficient building design. Three facts are becoming increasingly clear: Standard 90 is inadequate in setting the direction for conservation in new buildings; design professionals need to be sensitized to the energy performance of the building envelope; and construction detailing of building envelope assemblies is frequently deficient. While no quantitative estimate is available of the energy wasted in this latter case, the loss cannot be underestimated.

31212 (ASHRAE/SP—28, pp 595-606) **Implementation of building energy standards in New York State.** Albrecht, R.J.; Jones, J.D. (New York State Energy Office, Albany). 1981. NTIS, PC A99/MF A01. File Number DE83014620. (CONF-791233—).

From Conference on thermal performance of the exterior envelopes of buildings; Orlando, FL, USA (3 Dec 1979).

The development of energy efficiency standards for new and renovated buildings in New York state is described. Educational activities and the technical assistance program associated with the Energy Code are also described. The standardization of procedures and test methods for energy code compliance are discussed.

31213 (ASHRAE/SP—28, pp 638-650) **Sandwich panels with foamed polyurethane insulation.** Larsson, L.E. (Chalmers Tekniska Hoegskola, Goeteborg, Sweden). 1981. NTIS, PC A99/MF A01. File Number DE83014620. (CONF-791233—).

From Conference on thermal performance of the exterior envelopes of buildings; Orlando, FL, USA (3 Dec 1979).

A large number of long-term tests (most tests over 7 years) on sandwich panels comprising thermal insulation of foamed polyurethane of 30-40 kg/m^3 density and different thicknesses, and different facing layers such as glass fibre reinforced polyester, plasterboard, chipboard, wood fibre board, asfaboard, plywood and steel sheeting demonstrate that the very good thermal insulation properties of foamed polyurethane, apparent thermal conductivity $\lambda = 0.017 - 0.024\ W/m^{\circ}C$ ($0.12 - 0.17\ BTU \times in/h\ ft^{2\circ}F$) in the different tests, are not changed over a period of time. Test loading of wall and floor panels has shown that these panels can easily be constructed in such a way as to satisfy code requirements relating to loadbearing capacity and limitation of deformations, for instance in single-family houses. Fire tests show that the inside facing layer is critical with regard to the fire resistance of the construction. A wall panel comprising a loadbearing timber frame, 110 mm thermal insulation of foamed polyurethane and an inside facing layer of 15 mm glass fibre reinforced plasterboard resisted a standard fire in conformity with ISO 834 for 35 minutes without failure in the wall subjected to a compressive force. There was no rise in temperature at all on the side remote from the fire. Evolution of smoke was of limited extent.

31214 (ASHRAE/SP—28, pp 662-677) **Thermophysical properties data base activities at Owens-Corning Fiberglas.** Wilkes, K.E. (Owens-Corning Fiberglas, Granville, OH). 1981. NTIS, PC A99/MF A01. File Number DE83014620. (CONF-791233—).

From Conference on thermal performance of the exterior envelopes of buildings; Orlando, FL, USA (3 Dec 1979).

The success of any modeling effort depends upon the material property data used as input. To provide a firm foundation for our modeling efforts an activity was started at the Owens-Corning Fiberglas Technical Center for development of a data base of thermophysical properties of building materials. The purpose of this paper is to review the rationale for and the activities in this effort. Deficiencies in existing compilations of property data and the need for an expanded data base are discussed. Sources of literature data and the steps taken to collect and archive original references are described. A description is given of the steps taken to utilize the literature data. Included are details of the tabulations of property data, statistical analyses of data, and the generation of recommended sets of property values. Examples are given of the information contained in a data book being prepared, including tabular and graphical displays of data, and recommended equations.

31215 (ASHRAE/SP—28, pp 757-780) **Principles of building science and thermography needed to diagnose the performance of building enclosures.** Mill, P.A.D. (Public Works Canada, Ottawa, Ontario). 1981. NTIS, PC A99/MF A01. File Number DE83014620. (CONF-791233—).

From Conference on thermal performance of the exterior envelopes of buildings; Orlando, FL, USA (3 Dec 1979).

Effective preventive maintenance can be applied to buildings, through improvements in diagnostic techniques and developments of building science knowledge. Recent developments in the field of thermography demonstrate that an infrared camera operator, with expertise in building science, can accurately interpret thermal images. The application of thermography is the technique used to produce heat pictures from invisible radiant energy. The objective, at all levels of thermography, is to assess the thermal efficiency of building enclosures by measuring the varying levels of thermal radiation. At present, building science knowledge is not being applied to identify problems correctly, or to recommend and implement remedial measures. Thermography contributes to the effective application of this knowledge. The biggest dollar savings from Energy Efficiency programs comes from preventing enclosure degradation in the short term, and energy savings through improved efficiency of the enclosure in the long term.

31216 (ASHRAE/SP—28, pp 930-941) **Mobile window thermal test facility (MoWiTT).** Klems, J.H.; Selkowitz, S.E. (Lawrence Berkeley Lab., CA). 1981. NTIS, PC A99/MF A01. File Number DE83014620. (CONF-791233—).

From Conference on thermal performance of the exterior envelopes of buildings; Orlando, FL, USA (3 Dec 1979).

A Mobile Window Thermal Test Facility is currently being developed as part of the LBL energy Efficient Windows Program. The MoWiTT concept, design goals, and instrumentation system are described.

31217 (ASHRAE/SP—28, pp 952-964) **Aged thermal resistance (R value) of foil-faced polyisocyanurate foam thermal insulation board.** Sherman, M. (Jim Walter Research Corp., St. Petersburg, FL). 1981. NTIS, PC A99/MF A01. File Number DE83014620. (CONF-791233—).

From Conference on thermal performance of the exterior envelopes of buildings; Orlando, FL, USA (3 Dec 1979).

The aged thermal resistance (R value) of gas-barrier quality aluminum foil-faced polyisocyanurate foam thermal insulation board has been determined in ASTM C236 guarded hot box tests conducted in three qualified testing laboratories on full-size boardstock. Common-lot materials were measured in 1976 (15 to 33 months after manufacture) and retested in 1978-1979 (47 to 68 months after manufacture). Analysis of results indicates: (1) Essentially no change in R per inch thickness over this extended (15 through 68 months) period of time after product manufacture with or without glass fiber reinforcement. (2) Demonstrated low order magnitude of change in average R per inch from one month after manufacture (8.34) to time-aged plateau (7.04): approximately 15%. (3) The linearity of aged R value with product thickness at three mean temperatures: (a) 7.81 R/inch at 40°F mean temperature; (b) 7.04 R/inch at 75°F mean temperature; (c) 6.39 R/inch at 110°F mean temperature. (4) A linear relationship between R/inch and insulation mean temperature; an increase of 0.021 R/inch with each °F decrease in mean temperature, in the temperature range investigated. (5) Confirmation of the precision capability of the ASTM C236 Guarded Hot Box test method conducted in three NVLAP-accredited testing facilities; individual laboratory averages within 5% of three-laboratory averages; three-laboratory averages with coefficients of variation within 2.5 to 3.6%.

31218 (ASHRAE/SP—28, pp 987-1004) **Impact of insulation placement on the seasonal heat loss through basement and earth-sheltered walls.** Meixel, G.D.; Shipp, P.H.; Bligh, T.P. (Univ. of Minnesota, Minneapolis). 1981. NTIS, PC A99/MF A01. File Number DE83014620. (CONF-791233—).

From Conference on thermal performance of the exterior envelopes of buildings; Orlando, FL, USA (3 Dec 1979).

A transient, finite difference computer program has been developed and utilized to investigate the dynamic thermal performance of basement and earth-sheltered walls to determine the spatial and temporal characteristics of the heat flux through these walls. Comparisons between underground walls and between underground and aboveground walls serve to: (1) delineate limitations of the current American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE) recommended procedure for assessing the heat loss through basement walls; (2) present evidence for the possibility of freeze/thaw or frost-heave damage to inappropriately insulated basement walls; and (3) demonstrate the significant benefits to the annual energy balance that can be achieved through appropriate insulation to take maximum advantage of both the thermal buffering characteristic of the soil mass and its potential as a heat sink. These initial studies of several different insulation configurations highlight critical aspects of effective insulation strategies for earth sheltered walls.

31219 (ASHRAE/SP—28, pp 16-32) **Proposed streamlined residential heating. Energy budget analysis by a variable temperature design method.** Hans, G.E. (Dept. of Agriculture, Madison, Wisconsin). 1981. NTIS, PC A99/MF A01. File Number DE83014620. (CONF-791233—).

From Conference on thermal performance of the exterior envelopes of buildings; Orlando, FL, USA (3 Dec 1979).

A method for residential heating load calculations based on recognition of variable reference temperatures is presented. The method permits streamlined consideration of solar energy credits in design analysis.

31220 (ASHRAE/SP—28, pp 73-82) **Computer-aided energy savings redesign of the exterior envelope of an apartment building.** Mueller, G.R.; Pedreyra, D.C. (Mueller and Pedreyra Consulting Engineers, Englewood, CO). 1981. NTIS, PC A99/MF A01. File Number DE83014620. (CONF-791233—).

From Conference on thermal performance of the exterior envelopes of buildings; Orlando, FL, USA (3 Dec 1979).

A finite difference thermal analyzer was used to predict energy savings affected by redesign of the exterior envelope of a Denver hi-rise apartment building. The redesigned building utilized passive solar features that will save 40% of the energy required for the original building and can increase the comfort level during the hot summer months. The thermal modeling technique is described in detail for three building configurations. The passive solar elements investigated included building orientations, thermal mass of wall and size and shading of windows. Monthly energy requirements for each configuration are presented in tabular form.

31221 (ASHRAE/SP—28, pp 138-148) **Analysis of infiltration by tracer gas technique, pressurization tests, and infrared scans.** Stewart, M.B.; Jacob, T.R.; Winston, J.G. (Owens-Corning Fiberglass, Granville, OH). 1981. NTIS, PC A99/MF A01. File Number DE83014620. (CONF-791233—).

From Conference on thermal performance of the exterior envelopes of buildings; Orlando, FL, USA (3 Dec 1979).

The natural ventilation experienced by three unoccupied houses was measured over a one year period by a tracer gas technique. An energy audit was also performed using a fan to pressurize and depressurize the house along with an infrared scanner to detect the leakage paths. The houses were of a standard design and identical except for insulation levels. All houses were built by the same contractor at the same time. The tracer gas measurements were converted to a format similar to the pressurization results by using a previously developed model. The two methods placed the houses in the same relative ranking in terms of leakiness but the pressurization technique indicated much smaller differences than did the tracer gas technique.

31222 (ASHRAE/SP—28, pp 178-194) **Air leakage characteristics and weatherization techniques for low-income housing.** Grot, R.A.; Clark, R.E. (National Bureau of Standards, Washington, DC). 1981. NTIS, PC A99/MF A01. File Number DE83014620. (CONF-791233—).

From Conference on thermal performance of the exterior envelopes of buildings; Orlando, FL, USA (3 Dec 1979).

Data are presented on the air leakage characteristics of approximately 250 dwellings occupied by low-income households in 14 cities, in all major climatic zones of the US. Two types of measurements were used: a tracer-gas decay technique using air sample bags, which was developed at the National Bureau of Standards to measure natural air infiltration; and a fan depressurization test that measures induced air exchange rates. The data presented here show that for this group of dwellings natural air infiltration rates are distributed approximately lognormally. The induced air exchange rates are a measure of the tightness of building envelopes. There is little correlation between the natural air infiltration rates and the induced air exchange rates in these dwellings, unless the buildings are divided into classes of similar buildings. The use of fan depressurization as a diagnostic tool to assist weatherization crews in tightening buildings is discussed. Preliminary estimates are presented of the reduction in induced air exchange rates that may be achieved by applying building weatherization techniques.

31223 (ASHRAE/SP—28, pp 195-217) **Air leakage measurement and reduction techniques on electrically heated homes.** Collins, J.O. Jr. (Johns-Manville Sales Corp., Denver, CO). 1981. NTIS, PC A99/MF A01. File Number DE83014620. (CONF-791233—).

From Conference on thermal performance of the exterior envelopes of buildings; Orlando, FL, USA (3 Dec 1979).

Under the sponsorship of the Electric Power Research Institute, Johns-Manville undertook a two year program to evaluate the effect of air leakage on the heating requirements of 29 electrically heated homes in the Denver, Colorado area. Following the measurement of the rate of induced air leakage using the Super Sucker, the 29 homes were retrofitted specifically to minimize leakage and subsequently retested. Thirty similar homes were also tested for leakage and retained as controls. The Public Service Company of Colorado, a major participant in the program, fitted all of the 59 homes with submeters to measure the energy consumption associated solely with heating. They have also undertaken the reading of these meters each month, the compilation of an energy profile for each house, and the issuance of a monthly questionnaire to each homeowner relating to energy conservation methods or life style changes which might affect the measured heating energy usage. Their contribution to the program has been invaluable. This paper describes the retrofit methods, their effect upon the induced air leakage, the other data which are being collected, and the data analyses which are expected at the completion of the program.

31224 (ASHRAE/SP—28, pp 250-261) **Comparison of BTR measurements.** Janssen, J.E.; Pearman, A.N. (Honeywell Inc., Minneapolis, MN). 1981. NTIS, PC A99/MF A01. File Number DE83014620. (CONF-791233—).

From Conference on thermal performance of the exterior envelopes of buildings; Orlando, FL, USA (3 Dec 1979).

Evaluation of the effectiveness of building insulation is a task of growing importance. Five different methods are described for measuring or computing the overall Building Thermal Resistance of a residential structure. Data comparing the methods are presented for a one story, slab-on-grade house located in southern California. Results generally agree within +5% of the ASHRAE calculation procedure.

31225 (ASHRAE/SP—28, pp 262-268) **Calorimeter for measuring heat flow through walls.** Brown, W.C.; Schuyler, G.D. (National Research Council of Canada, Ottawa, Ontario). 1981. NTIS, PC A99/MF A01. File Number DE83014620. (CONF-791233—).

From Conference on thermal performance of the exterior envelopes of buildings; Orlando, FL, USA (3 Dec 1979).

Studies on residential energy use have indicated a need for field measurement of heat loss from houses. One of the prime areas of loss is transmission heat loss through the building envelope. Field measurement of heat loss through the basement walls and floor, the above-grade walls and the ceiling is useful in establishing the energy balance in a house. The field measurement of heat loss from these areas is also useful in comparing in-situ heat loss with heat loss predicted from steady-state thermal properties and field climatic conditions. The measurement of heat flow in the field requires a calorimeter that does not affect the heat flow it is meant to measure; that is, it must not alter the surface temperature of the specimen. For field measurement the calorimeter should be simple to operate yet reasonably accurate, and it must be portable. The calorimeter must meter a large area to permit determination of a representative heat loss value, because of the inhomogeneous nature of building elements and the temperature variation over their surfaces. This paper describes the construction, accuracy check and use of a portable calorimeter developed primarily for a study on energy conservation in four experimental houses, undertaken by the

Division of Building Research, National Research Council of Canada.

31226 (ASHRAE/SP—28, pp 381-391) **Dynamic response of conventional residential construction to solar radiation through windows during the heating season.** Cumali, Z.O.; Sullivan, R.; Sezgen, A.O.; Hossli, R.I. (Consultants Computation Bureau/Cumali Associates, Oakland, CA). 1981. NTIS, PC A99/MF A01. File Number DE83014620. (CONF-791233—).

From Conference on thermal performance of the exterior envelopes of buildings; Orlando, FL, USA (3 Dec 1979).

A significant potential for increasing the contribution of solar heating during the heating season has been overlooked. This increase can be effected by improving the orientation of standard windows and sliding glass doors in conventional low-mass residential buildings. Currently, building regulations do not provide incentives for placing more glass on south facing walls. There is no standard calculating procedure; hence, overheating may occur when glazed areas are too large for low-mass construction. The National Fenestration Council is sponsoring this study to develop recommendations for maximum glazing areas and to investigate the effect of this glazing on summer cooling loads. This paper details the definition and structure of a comprehensive parametric study which treats the thermal response of a typical single family residence. A representative range of climate zones and geographical orientations, two floor structures and two air-circulation schemes are to be made in the course of an analysis which features a primary parametric on south facing window sizing. A modified version of the DOE-2A energy analysis program will be used in the study. It is intended that the results will yield sufficient data to support recommendations on optimum glazing areas for low-mass construction.

31227 (ASHRAE/SP—28, pp 436-455) **Modeling of residential attics.** Wilkes, K.E. (Owens-Corning Fiberglas, Granville, OH). 1981. NTIS, PC A99/MF A01. File Number DE83014620. (CONF-791233—).

From Conference on thermal performance of the exterior envelopes of buildings; Orlando, FL, USA (3 Dec 1979).

A review is given of the available models that have been used to predict the thermal performance of residential attics. The models are first compared qualitatively on the basis of the following features: treatment of ventilation air, inclusion of heat capacities of the roof, ceiling and air space, treatment of radiation heat exchanges, inclusion of heat transfer through gable ends, and dependence of heat transfer coefficients upon temperature and temperature difference. A brief description is then given of a facility for measurements of attic thermal performance under simulated steady-state and dynamic conditions. Included in this description are the boundary conditions to be imposed on attic test sections. Ceiling heat fluxes and attic air temperature predicted by the various models are then compared to some preliminary results of tests under controlled conditions.

31228 (ASHRAE/SP—28, pp 456-471) **Mathematical modeling and computer simulation of insulation systems in below grade applications.** Wang, F.S. (Dow Chemical U.S.A., Granville, OH). 1981. NTIS, PC A99/MF A01. File Number DE83014620. (CONF-791233—).

From Conference on thermal performance of the exterior envelopes of buildings; Orlando, FL, USA (3 Dec 1979).

A finite element program for simulating two-dimensional heat conduction in foundation and basement walls and slab-on-grade systems is presented. Ground freezing and thawing are treated in the model and time-dependent boundary conditions can be stipulated. Some results of heat loss studies of basement walls with and without insulation are described.

31229 (ASHRAE/SP—28, pp 493-507) **Method of rating the thermal efficiency of a home envelope relative to an energy efficient standard.** Blancett, R.S. (Owens-Corning Fiberglas, Granville, OH). 1981. NTIS, PC A99/MF A01. File Number DE83014620. (CONF-791233—).

From Conference on thermal performance of the exterior envelopes of buildings; Orlando, FL, USA (3 Dec 1979).

A method was developed for rating the thermal efficiency of a home envelope relative to energy efficient standards. The method was developed at the request of the US League of Savings Associations for use by real estate appraisers or lending officials and is a Class B type audit procedure. A scorecard is utilized where points are awarded for energy conserving features of a home envelope. The scorecard is used to compare points awarded to points based on an energy efficient standard. Homes with a low relative rating are identified as potential retrofit candidates. Retrofit measures are assigned a priority relative to cost of the retrofit and benefits obtained. The method considers envelope retrofit options which reduce heating requirements.

31230 (ASHRAE/SP—28, pp 522-540) **Economic considerations in insulating masonry and wood-frame walls of single-family housing.** Petersen, S.R. (National Bureau of Standards, Washington, DC). 1981. NTIS, PC A99/MF A01. File Number DE83014620. (CONF-791233—).

From Conference on thermal performance of the exterior envelopes of buildings; Orlando, FL, USA (3 Dec 1979).

Maximum economic levels of insulation in masonry walls are expected to be lower than those for wood-frame walls in many parts of the US for two reasons: (1) insulation costs are significantly higher for masonry walls, and (2) energy savings are somewhat lower because of differences in the dynamic thermal performance of the two wall types. This report examines the impact of both of these factors in determining economically optimal insulation levels for several types of wall construction used in single-family housing, over a wide range of geographic locations. The NBSLD computer program is used to calculate reductions in annual heating and cooling requirements due to several levels of insulation in each of four wall variations examined. Economically optimal insulation levels (based on life-cycle cost analysis) are calculated for a wide range of assumptions related to climate, energy prices, insulation costs, and present worth factors.

31231 (ASHRAE/SP—28, pp 541-569) **Economic comparison and thermal performance of several different insulated wall constructions.** Yuill, G.K.; Proskiw, G. (UNIES Ltd., Winnipeg, Manitoba). 1981. NTIS, PC A99/MF A01. File Number DE83014620. (CONF-791233—).

From Conference on thermal performance of the exterior envelopes of buildings; Orlando, FL, USA (3 Dec 1979).

Field measurements were performed on five electrically heated, unoccupied houses with different types of exterior wall sections, to determine their comparative energy consumption characteristics. Three of the houses used fiberglas insulation and various types of stud frame construction while the remaining two houses utilized log construction techniques. The data generated over the 15 day test period was in close correlation to comparative, predicted patterns calculated using the Net Annual Heat Loss Factor (NAHLF) method. The tests also showed that the energy savings predicted for the extra insulation levels in the stud frame walls were realized in practice. Both log structures exhibited higher heat losses than any of the frame walls, primarily due to very high air infiltration rates. An economic analysis revealed that the extra costs for the stud walls, triple glazing and higher ceiling and floor insulation levels were easily justified. A comparison between electric resistance heating costs in Canada and the US indicated that American insulation levels should be as high or higher than Canadian levels despite the climatic differences.

31232 (ASHRAE/SP—28, pp 651-661) **Performance of an energy efficient residence vs a conventional comparison home.** Johnson, R.J. (NAHB Research Foundation, Inc., Rockville, MD). 1981. NTIS, PC A99/MF A01. File Number DE83014620. (CONF-791233—).

From Conference on thermal performance of the exterior envelopes of buildings; Orlando, FL, USA (3 Dec 1979).

How much energy can be saved in a typical new home with off-the-shelf products and techniques? Are the savings worth the extra cost? Do predicted energy savings agree with actual energy savings? To answer these and many more practical questions, the Technology and Energy Conservation Division of Policy Development and Research of the Housing and Urban Development Department sponsored the design and construction of an Energy Efficient Residence (EER) and a Conventional Comparison Home (CCH) by the NAHB Research Foundation, Incorporated. Detailed operating data for both homes while occupied for one complete calendar year, February 1, 1978 to January 31, 1979 are presented.

31233 (ASHRAE/SP—28, pp 751-756) **Transient thermal response of an intermittently cooled massive building.** Gujral, P.S.; Clark, R.J.; Burch, D.M. (National Bureau of Standards, Washington, DC). 1981. NTIS, PC A99/MF A01. File Number DE83014620. (CONF-791233—).

From Conference on thermal performance of the exterior envelopes of buildings; Orlando, FL, USA (3 Dec 1979).

A one-room externally insulated masonry test structure was built inside an environmental chamber at the National Bureau of Standards. This structure was exposed to diurnal sol-air summer temperature cycles, and two energy conservation schemes were investigated. For both schemes, the interior mass of the structure was cooled during the night hours, first by mechanical cooling and second by ventilation with outdoor air. The results indicated that mechanical cooling effectively cooled the interior mass during the night hours such that no additional daytime cooling was needed for even the most extreme summer conditions. The tests further indicated that ventilation with outdoor air effectively cooled the structure to the point where no mechanical cooling was needed for summer conditions representative of many parts of the US. The experimental test results compared well with those obtained from an analytical model.

31234 (ASHRAE/SP—28, pp 801-815) **Field study of moisture damage in walls insulated without a vapor barrier.** Tsongas, G.A.; Odell, F.G.; Thompson, J.C. (Portland State Univ., OR). 1981. NTIS, PC A99/MF A01. File Number DE83014620. (CONF-791233—).

From Conference on thermal performance of the exterior envelopes of buildings; Orlando, FL, USA (3 Dec 1979).

Considerable uncertainty has existed over whether or not wall insulation installed without a vapor barrier causes an increased risk of moisture damage (wood decay) within walls. This paper describes the results of a study aimed at finding out if such a moisture problem really exists. The exterior walls of a total of 96 homes in Portland, Oregon were opened, of which 71 had retrofitted insulation (three types) and 25 were uninsulated. Field and laboratory test results are presented which show the absence of moisture accumulation, and wood decay fungi, or other indications of moisture damage in the walls of the test homes. Data on shrinkage and settling of insulation are also given, as are results of air leakage measurements by fan depressurization tests. The study concludes that the addition of wall insulation without a vapor barrier does not cause moisture damage in existing homes with wood siding in climates similar to that of Western Oregon. The overall advisability of future retrofitting of wall insulation is discussed.

31235 (ASHRAE/SP—28, pp 816-835) **Effect of moisture on the thermal conductance of roofing systems.** Knab, L.I.; Jenkins, D.R.; Mathey, R.G. (National Bureau of Standards, Washington, DC). 1981. NTIS, PC A99/MF A01. File Number DE83014620. (CONF-791233—).

From Conference on thermal performance of the exterior envelopes of buildings; Orlando, FL, USA (3 Dec 1979).

The results of laboratory tests are presented describing the effect of moisture content on the thermal conductance of roofing systems containing insulation. Roofing systems, consisting of five types of rigid-board roof insulations with attached four-ply bituminous built-up membrane, were tested. Moisture was induced into the roofing system specimens by maintaining a constant water vapor pressure difference across them. Moisture gain in the insulation varied depending on the type and thickness of the insulation. A procedure was developed, using a heat-flow meter apparatus (ASTM C 518 type), to carry out thermal conductance tests on roofing specimens containing moisture. More than 200 tests were performed over a wide range of moisture contents. The approximate moisture distribution in the insulation was determined from core samples. Relationships between the thermal conductance and moisture content are presented. The relationships show that the presence of moisture in roofing systems can cause significant increases in thermal conductance, depending on the type and thickness of the insulation.

31236 (ASHRAE/SP—28, pp 836-846) **Comparative studies of vapor condensation potentials in wood framed walls.** Wang, F.S. (Dow Chemical, Granville, OH). 1981. NTIS, PC A99/MF A01. File Number DE83014620. (CONF-791233—).

From Conference on thermal performance of the exterior envelopes of buildings; Orlando, FL, USA (3 Dec 1979).

Vapor condensation in exterior walls can affect the performance of thermal insulation but quantitative assessments of this effect are lacking. This study explored the sensitivity of the condensation potential in relation to insulation position. A moisture balance was performed for a hypothetical house to illustrate the relative significance of vapor transport modes. A controlled field test experiment was also performed and the results are presented.

31237 (ASHRAE/SP—28, pp 856-874) **Ventilation of back space of building enclosure siding for solar heat gain reduction.** Homma, H.; Guy, R.W. (Toyohashi Univ. of Technology, Japan). 1981. NTIS, PC A99/MF A01. File Number DE83014620. (CONF-791233—).

From Conference on thermal performance of the exterior envelopes of buildings; Orlando, FL, USA (3 Dec 1979).

The effect of ventilation in the space between a main wall and an exterior siding is examined with respect to reducing the building's cooling load. The buoyant force of the air in the space is considered as the motive force of air flow and the effect is treated as a problem of simultaneous heat and mass-transfer. A simulation program of heat and air flows in a wall has been developed using laminar flow theory, and its validity is examined by the comparison of the simulation results with a weather exposed full-scale model test. The computer simulation shows that the ventilation of air spaces has the potential to reduce the radiative heat gain of both opaque walls and of triple glass windows.

31238 (ASHRAE/SP—28, pp 875-886) **Experimental investigation of the effect of added insulation on water vapor condensation in mobile home roof cavities.** Carlson, T.C.G.; Luce, R.G. (Owens-Corning Fiberglas, Granville, OH). 1981. NTIS, PC A99/MF A01. File Number DE83014620. (CONF-791233—).

From Conference on thermal performance of the exterior envelopes of buildings; Orlando, FL, USA (3 Dec 1979).

The influence of increasing thermal insulation in the attic space of mobile home roofs on water vapor transport and water damage was investigated. Two laboratory environmental test chambers were designed and constructed to simulate outside winter ambient and interior mobile home living space conditions. In addition the effect of roof skin heating due to sunlight was also simulated. Two basic roof section designs, each with three thermal insulation configurations, were examined. These were a standard and a raised-heel bow truss. The test specimens were constructed using actual mobile home roof construction procedures and materials. Based on the measured test results and post-test visual observations, it was concluded that added levels of thermal insulation in the attic space of mobile home roofs will not increase condensation or water damage, provided an effective vapor barrier is installed above the ceiling board. In addition, test results indicated that condensation may form between the vapor barrier and ceiling board for roof sections having either conventional insulating packages or increased insulation packages. It was observed that for all insulating systems, moisture condensation occurred on the warm side of the vapor barrier where the ceiling boards were fastened to the wooden trusses. Further examination of this problem is planned.

31239 (ASHRAE/SP—28, pp 887-897) **Annual cycle moisture analysis.** Stewart, M.B. (Owens-Corning Fiberglas, Granville, OH). 1981. NTIS, PC A99/MF A01. File Number DE83014620. (CONF-791233—).

From Conference on thermal performance of the exterior envelopes of buildings; Orlando, FL, USA (3 Dec 1979).

The method currently used to screen construction types for possible condensation is the steady state ASHRAE dew point technique. This method estimates the outside conditions necessary to produce condensation within the wall but ignores the dynamics involved in daily and seasonal cycling of temperature and humidity. Other important characteristics of walls include the total amount of moisture accumulated during the winter and the length of time the moisture remains in the wall during the spring and summer months. This paper examines the effect of location and magnitude of the permeance of building materials, solar heating, daily and seasonal climatic variations, indoor relative humidity, and insulation level on the dynamic moisture behavior of a wall. Hourly calculations using weather data from the Minneapolis area are used to determine dynamic behavior for several wall types. Limitations of this method are discussed.

31240 (ASHRAE/SP—28, pp 901-915) **Field survey of the performance properties of insulation used to retrofit cavity walls of residences.** Rossiter, W.J. Jr.; Weidt, J.L.; Saxler, R.J. (National Bureau of Standards, Washington, DC). 1981. NTIS, PC A99/MF A01. File Number DE83014620. (CONF-791233—).

From Conference on thermal performance of the exterior envelopes of buildings; Orlando, FL, USA (3 Dec 1979).

A study was conducted to obtain information on the performance of retrofit insulations which had been installed in the sidewalls of existing residences. Most of the thirty-nine houses included in the study had wood-frame sidewall construction and were located in the mid-west, mid-Atlantic and Northeast. The insulations represented those commonly used in the US to retrofit sidewalls of housing: urea-formaldehyde based foam, loose-fill cellulose, and loose-fill mineral fiber. With few exceptions, the insulations had been installed in the sidewalls at least 2 years prior to their examination and their ages ranged from about one and a half to ten years. In the field phase of the study, small sections of sidewalls were opened in the late fall or early winter and the retrofit insulations were examined. Observations were made on performance factors such as: the completeness of filling the cavity, the condition of the insulation and wall components, and evidence of moisture accumulation such as water stains on sheathing, studs and other wall components. In the laboratory phase of the study, insulation specimens removed from the walls of the residences were tested to determine their density, thermal resistivity and moisture content. In addition, the pH of the urea-formaldehyde based foam specimens was determined. Results of the laboratory measurements are discussed and compared with data and information obtained from other studies. Results indicated that the retrofitting of the inspected sidewalls was for the most part accomplished without adverse effect upon them.

31241 (ASHRAE/SP—28, pp 916-929) **Recommended insulation retrofit techniques for mobile homes with a simple payback analysis.** Carlson, T.C.G.; Bemis, R.S. (Owens-Corning Fiberglas Technical Center, Granville, OH). 1981. NTIS, PC A99/MF A01. File Number DE83014620. (CONF-791233—).

From Conference on thermal performance of the exterior envelopes of buildings; Orlando, FL, USA (3 Dec 1979).

A study was conducted to identify techniques for reinsulating mobile home roofs, sidewalls, and floors and for investigating economic incentives that might lead the homeowner to take such action. Since mobile homes are significantly different than site built homes, this study went beyond conventional reinsulation techniques, as many of them would not be applicable to mobile homes. Seven retrofit techniques were evaluated; four for the roof cavity, two for sidewalls, and one for floors, using conventional insulation materials. Actual mobile homes or mock-up structures were used for the evaluation. To determine the economic feasibility of reinsulating mobile homes, thermal and economic analyses were prepared. The thermal analysis was based on steady state one dimensional heat transfer, the economic analysis on simple payback. Maximum existing insulation levels for which it would still be economically worthwhile to upgrade insulation were determined based on a sample 7-year payback period. The analyses examined four modes of heating and cooling and utilized 1978 utility rates. They were performed on mobile home roofs, sidewalls, and floors for 256 US cities, with results summarized by six climatic zones. Two of the retrofit techniques evaluated for roof cavities, one for sidewalls, and one for floors are recommended for use. The analyses have shown that candidate mobile homes will meet a 7-year payback criterion in most climatic zones when low-levels or no insulation exists in the roof, sidewall, and floor cavities.

31242 (ASHRAE/SP—28, pp 965-977) **Effective thermal performance of an insulated standard stud wall containing air gaps.** Tye, R.P.; Desjarlais, A.O.; Bourne, J.G.; Spinney, S.C. (Fiber Materials, Biddeford, ME). 1981. NTIS, PC A99/MF A01. File Number DE83014620. (CONF-791233—).

From Conference on thermal performance of the exterior envelopes of buildings; Orlando, FL, USA (3 Dec 1979).

An experimental investigation of the effective performance of a cavity wall assembly has been undertaken using the standard guarded hot box procedure. Measurements of the thermal conductance were obtained with the cavities completely filled with a cellular plastic and then partially filled with accurately machined pieces of the same cellular plastic which simulated different sizes, positions and orientations of air gaps, particularly representative of those due to shrinkage. The results indicate that there is a direct relationship between effective thermal performance and size of air gap of the order to 5% loss for each 1% of shrinkage. The results are both analyzed and compared with previous analyses for such systems and discussed with respect to installation, aging and other factors affecting in situ performance. The results have been used to calculate derating factors for the effective thermal resistances. The results confirm the validity of the NBS Derating Analysis for deriving effective resistance of materials which shrink within a cavity.

31243 (ASHRAE/SP—28, pp 160-177) **Air exchange measurements in a high-rise office building.** Hunt, C.M.; Treado, S.J. (National Bureau of Standards, Washington, DC). 1981. NTIS, PC A99/MF A01. File Number DE83014620. (CONF-791233—).

From Conference on thermal performance of the exterior envelopes of buildings; Orlando, FL, USA (3 Dec 1979).

Air exchange rates were measured in the tower of an 11-story office building using SF_6 as a tracer gas. Inside-outside pressure difference measurements were also monitored as a function of temperature and wind speed. Fall and winter air exchange rates, I (hr^{-1}), measured with make-up and main exhaust pathways blocked could be represented as a function of wind speed, W (mi/hr), by the equation $I = 1.08 + 0.036W - 0.0005W^2$, $\sigma = 0.15$. Wind direction and temperature difference (stock effect) exerted little effect on air exchange rate. In this building, toilet exhausts and other weather independent mechanisms were more important than natural infiltration in producing air exchange. Also, a preliminary analysis of predicted air infiltration by the Shaw-Tamura model was undertaken. The results of this preliminary analysis were consistent with the observations that the stack effect was unimportant and that natural infiltration contributed only part of the total air exchange. However, the plot of calculated infiltration rate as a function of wind speed, using the Shaw-Tamura model, had a different form from the plot of measured data.

31244 (ASHRAE/SP—28, pp 354-367) **Thermal performance of vinyl covered fiberglass solar screens.** Brakefield, C.; Hein, D.E. (Phifer Wire Products, Inc., Tuscaloosa, AL). 1981. NTIS, PC A99/MF A01. File Number DE83014620. (CONF-791233—).

From Conference on thermal performance of the exterior envelopes of buildings; Orlando, FL, USA (3 Dec 1979).

During the past decade, vinyl covered fiberglass solar screening has evolved from insect screening with a capability, as judged by shading coefficients, of eliminating up to 75% of the summer solar heat gain. Calculated results of heat transfer coefficients (4 values) for a single pane window system in winter heating conditions have suggested some dramatic reductions in thermal transmittance with the addition of solar screens. This paper addresses the thermal performance of a porous screening applied to fenestration products and its effect on the annual energy balance. The program utilized the latest technology for evaluating thermal performance under accepted laboratory controlled environments for summer and winter conditions, both daytime and nighttime.

31245 (ASHRAE/SP—28, pp 781-797) **Thermal performance of the Norris Cotton Federal Building in Manchester, New Hampshire.** Richtmyer, T.E.; May, W.B.; Hunt, C.M.; Hill, J.E. (National Bureau of Standards, Washington, DC). 1981. NTIS, PC A99/MF A01. File Number DE83014620. (CONF-791233—).

From Conference on thermal performance of the exterior envelopes of buildings; Orlando, FL, USA (3 Dec 1979).

The Norris Cotton Federal Office Building is a medium-size 7-story government office building of approximately 11,000 m^2 (117,000 ft^2) total floor space. It is located in Manchester, New Hampshire and has been designed to demonstrate a number of energy saving concepts. Some of the major energy conserving features of the building are the use of solar collectors; heavy masonry construction with exterior insulation; small overall window area; heat recovery from heat pumps, chillers, a natural gas-powered engine/generator, and the ventilation system; modular boilers; thermal storage tanks; and a variety of energy conserving lighting systems. This paper will describe the building's thermal performance for the first three years of operation. The energy consumption in the building is presented and compared to the original design goal of 625 MJ/(m^2 x year) (55kBtu/(ft^2 x year)). The differences will be explained using the results of thermographic measurements and measurements of air exchange rates in the building along with analysis of the weather data and building operation problems that have occurred since 1976. It has been found that it is difficult to actually achieve designed-for performance in this building because its experimental mechanical system is unusually complex and its construction details are unconventional.

31246 (ASHRAE/SP—28, pp 942-951) **Energy conservation study for Puerto Rico Aqueduct and Sewer Authority building.** Fogleman, S.R. (Consulting Engineers and Energy Management Consultants of San Juan, Puerto Rico). 1981. NTIS, PC A99/MF A01. File Number DE83014620. (CONF-791233—).

From Conference on thermal performance of the exterior envelopes of buildings; Orlando, FL, USA (3 Dec 1979).

This paper is about the study and investigation of various energy conservation opportunities in connection with the building envelope and mechanical and electrical systems of the Puerto Rico Aqueduct and Sewer Authority building. The ten-story building, located in San Juan, has a gross floor area of 165,000 square feet and is used mainly for offices. The Cal/ERDA computer program (presently DOE-2) for energy utilization analysis of buildings was the principal basis for the calculations with manual and other computer calculations for wall and window heat transmission and solar heat gains used to complement the Cal/ERDA calculations. The results of the study of each Energy Conservation Opportunity is reported including yearly savings in electrical energy and the resulting pay back periods. Table shows comparable individual savings of all the various Energy Conserving Opportunities for 1 year, 5 years, and 10 years including long term monetary savings and savings in barrels of oil over a 20 year period. The results of the computer program evaluation indicates close agreement between the actual building energy consumption and that predicted by the computer calculations. The annual energy savings when all the energy conserving measures are combined amounts to 28% of the annual energy consumption with a pay back period of 18 months.

31247 (ASHRAE/SP—28, pp 368-380) **Energy potential of daylighting in a classroom.** Gillette, G. (National Bureau of Standards, Washington, DC). 1981. NTIS, PC A99/MF A01. File Number DE83014620. (CONF-791233—).

From Conference on thermal performance of the exterior envelopes of buildings; Orlando, FL, USA (3 Dec 1979).

An analysis is presented where a classroom of prescribed size and occupancy has various fenestration designs applied to it and the resulting thermal and daylighting energy performance calculated. An attempt is made to relate the heating/cooling requirements of a window opening with its potential as a source of natural light. The parameters glass area, glass type (double-pane, reflective, etc.), and ceiling height are evaluated for a classroom in Ann Arbor, Michigan operated over the course of a 9-month school year. Comparisons are made between the performance of a design based on ASHRAE Standard 90-75 and alternate fenestration designs. Although the computerized thermal analysis and the daylight analysis had to be done separately, actual weather data and corresponding daylight readings for Ann Arbor, Michigan are used for both. Results show a potential energy savings when daylighting is carefully integrated into the buildings envelope design, especially for southern exposures, but such savings will be realized only if applied with the other energy variables in mind.

31248 (ASHRAE/SP—28, pp 570-586) **Building envelope thermal performance standard, the Texas approach.** Hart, M.N.; Jones, J.W.; Bowen, W. (Energy Engineering Associates, Inc., Austin, TX). 1981. NTIS, PC A99/MF A01. File Number DE83014620. (CONF-791233—).

From Conference on thermal performance of the exterior envelopes of buildings; Orlando, FL, USA (3 Dec 1979).

In 1975, the State of Texas Legislature mandated that energy conservation standards be developed for new State buildings. The legislation called for the development of performance criteria and for guidelines for energy efficient design for different classes of state-owned or financed buildings. In response to this legislated mandate, the State Building Commission developed a standard which provided performance criteria for the building envelope and the building system components separately. The State of Texas Building Energy Conservation Standard is divided into sections on the envelope, mechanical equipment, lighting, and service hot water. The building envelope section provided a new approach intended to address concerns expressed by the state's architects. It sets thermal performance of the shell by specifying an Energy Envelope Index (EEI) as a function of building size and location. The standard is structured such that compliance with the EEI may be determined by the architect early in the design. The EEI method has proved to be a useful tool, aiding the architect in initial design decisions. The EEI considers the influence of geometric factors, climatological variables such as temperature and solar irradiation, and the interaction of internal and envelope loads. The EEI calculations are extensions of standard procedures for estimating loads (such as those published by ASHRAE). These procedures are summarized in this paper and highlighted with examples.

31249 (ASHRAE/SP—28, pp 678-694) **Analysis and measurement of the thermal behavior of the walls and surrounding soil for a large underground building.** Meixel, G.D. Jr.; Shipp, P.H.; Ramsey, J.W. (Owens-Corning Fiberglass, Granville, OH). 1981. NTIS, PC A99/MF A01. File Number DE83014620. (CONF-791233—).

From Conference on thermal performance of the exterior envelopes of buildings; Orlando, FL, USA (3 Dec 1979).

In a program designed to ascertain the merits of extending earth-sheltered design concepts to a large commercial structure, measurements and analyses are being conducted at the University of Minnesota. From measurements obtained for the 1978 calendar year at a earth-sheltered building on campus, the dynamic heat transfer interactions between the building walls and the surrounding soil have been demonstrated and experimental verification has been provided for a transient, finite difference heat transfer computer program developed for the analysis of earth-sheltered building envelopes. Computer generated contour plots detail the influence of the building and the seasonal fluctuations of the soil temperatures while graphically illustrating the thermal storage characteristics of the surrounding soil mass. Wall heat flux measurements have been made at regular intervals as well as soil temperature and moisture content measurements to determine the effect of different soil types and ground surface conditions around the building perimeter.

31250 (ASHRAE/SP—28, pp 631-637) **Thermal spacers improve roof insulation performance of metal buildings.** Waite, H.J.; Snyder, M.K. (Dow Chemical U.S.A., Granville, OH). 1981. NTIS, PC A99/MF A01. File Number DE83014620. (CONF-791233—).

From Conference on thermal performance of the exterior envelopes of buildings; Orlando, FL, USA (3 Dec 1979).

Measured U-values for insulated roofs of prefabricated metal buildings are considerably different from calculated U-values due to the synergism between insulation, fastener, and roof components in their fabricated state. A system of thermal spacers for improving performance of these roof types is described.

31251 (ASHRAE/SP—28, pp 847-855) **Moisture condensation above insulated suspended ceilings - experimental results.** Hart, G.H.; Carlson, T.C.G. (Owens-Corning Fiberglas, Granville, OH). 1981. NTIS, PC A99/MF A01. File Number DE83014620. (CONF-791233—).

From Conference on thermal performance of the exterior envelopes of buildings; Orlando, FL, USA (3 Dec 1979).

One of the common methods of reinsulating above the heated and cooled space of a commercial building is to apply insulation above the grid suspended ceiling. However, there is concern that during the heating season, moisture condensation problems may occur in the cool space (i.e., the plenum) between the roof and the insulated suspended ceiling. For this reason, an experimental program to determine humidity within a plenum above an insulated suspended ceiling as a function of plenum temperature and indoor relative humidity was undertaken. A test chamber was designed and constructed to simulate a cold plenum space and a warm, humidified interior living space. During the tests, the temperature in the warm space below the suspended ceiling was held at approximately 70 F while the relative humidity was incrementally increased to a level in excess of 60%. Temperatures in the plenum were lowered to a minimum value of 5 F. Water vapor moved through the ceiling panels at the rate allowed by the commercial materials and installation. The low vapor permeance of an actual built-up-roof system was simulated with a heavy plastic sheet. The results of the experimental work demonstrated that the simplified model currently used for predicting moisture concentrations in plenum spaces is not accurate. In addition, the experimental results and subsequent moisture migration calculations demonstrated that moisture condensation is not likely to be a problem above the insulated suspended ceilings investigated.

31252 (ASHRAE/SP—28, pp 978-986) **Direct approach to retrofitting - protected membrane roofing.** Deal, P.N. (Dow Chemical U.S.A., Granville, OH). 1981. NTIS, PC A99/MF A01. File Number DE83014620. (CONF-791233—).

From Conference on thermal performance of the exterior envelopes of buildings; Orlando, FL, USA (3 Dec 1979).

The use of extruded polystyrene boards applied on top of a waterproof membrane and weighted down with crushed stone is discussed as a suitable retrofitting measure for adding thermal insulation to the roofs of commercial/industrial buildings.

31253 (BFR-R—41-1983) **Heat abstraction with bottom-anchored cooling coils in stationary water. Laboratory trials.** Svensson, T.; Soerman, L.O. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1983. 62p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. File Number DE85750852.

Heat pump systems abstracting heat from the bottom of lakes by means of plastic pipes have captured a fraction of the market. The objective of this project has been to study in more detail the mechanisms of heat absorption and freezing around a 40/32.6 mm diameter PEL pipe lying on the bottom of stationary body of water, or possibly partly covered by the bottom sediment. Measurements have been made in a 0.8 m deep pool, with water temperatures varying between 0.5 C degrees and 5 C degrees, and with a heat flux from the bottom equivalent to that normally encountered in lakes under winter conditions. The work has shown that a pipe lying on a sandy bottom can absorb heat more or less effectively as a freely supported pipe. If the water temperature exceeds +1 C degree, the pipe can absorb 40 W/m or more (about 7 W/m.K). If the water temperature drops to +0.5 C degree, the growth of ice on the pipe tends to limit the maximum rate of heat abstraction to 20-25 W/m. If the pipe is just buried flush with the sand, the rate of heat absorption falls considerably (to about 4.5 W/m.K), with further reduction as the pipe becomes more deeply buried.

31254 (BFR-R—72-1983) **Absorption heat pumps for recovery of heat from flue gases. A technical/economic assessment.** Westermark, M. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1983. 61p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. File Number DE85750855.

The objective of this work has been to investigate suitable applications for large absorption heat pumps and to suggest suitable sites for trial installations as part of the program of research work of the Swedish Council for Building Research. The two following sites have been considered in more detail and are recommended for installations plants: - A plant in Trollhaettan, for recovery of industrial waste heat for supply to the local district heating system through heat exchangers and heat pumps. High-grade waste heat, in the form of steam, would be used as the drive energy. - A plant in Aadalen, for recovery of waste heat from water vapour in flue gases for supply to the local district heating system using heat exchanges and heat pumps. Heat from a peat-fired hot water boiler would be used as the drive energy. The report includes an investment budget and profitability calculations, together with comparisons with other alternatives. The conclusion is that both applications can be as niches in which absorption heat pumps are economically viable and fully competitive with other alternatives (e.g. mechanical heat pumps). It is therefore regarded as important to build these demonstration plants using absorption heat pumps for the applications considered.

31255 (BFR-R—75-1983) **Energy management in settlements with district heating.** Bergstroem, T.; Rosander, T. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1983. 77p. (In Swedish). NTIS (US Sales Only), PC A05/MF A01. File Number DE85750856.

The energy consumption of approximately 40000 flats has been investigated. The aim of the project was to clarify the feasibility of energy conservation by 30 percent in 10 years in district heating areas. Theoretical models have been compared with practical results. Theoretically some 22 percent should be possible to save. It has been practicable to measure the effect of various steps of energy conservation by follow-up during three years. This will give an energy conservation by 16 percent in 10 years. Together with already achieved results during 1978-1979 the calculated energy conservation will be about 28 percent. The case has been studied at Vaesteraas.

31256 (BFR-R—77-1984) **Future heating and electricity supply systems in Sweden. A study of three distinct cases from the national economic viewpoint.** Bengtsson, L.E.; Linden, B. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1984. 79p. (In Swedish). NTIS (US Sales Only), PC A05/MF A01. File Number DE85750869.

The object is to investigate theoretically and to show how the choice of different heating systems for buildings tends to influence the future electricity supply, fuel import and energy consumption in Sweden. The results indicate that surplus electric power yielded by nuclear power stations should be used for locally sited heat pumps. The method employed was to set up, on the basis of the heating requirement in Sweden, exclusive the industrial sector, and electric power production in 1981, three theoretical scenarios comprising different mixes of district heating and heat pumps. Prior to discontinuation of nuclear power production, the higher the proportion of heat pumps, the lower were the import costs for fuel and the lower the use of fossil fuels. After discontinuation of nuclear power production, when replacement for nuclear production was included, about the same amount of fossil fuel was used in all alternatives. A higher proportion of heat pumps requires higher initial investments, but is warrented by lower import costs.

31257 (BFR-R—115-1983) **Lake Vaettern as a heat source for heat pump. A regional investigation.** Svensson, T.; Broman, B. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1983. 65p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. File Number DE85750857.

The objective of this report is to collect information that can have a bearing on the use of water from Lake Vaettern as a heat source for heat pumps. The main item concerned is temperature data, although currents, waves and bottom conditions are also important for certain types of heat collection systems. The water temperature during the winter is probably the most important parameter. At depths of 20-25 m, temperatures below +2 C degrees are encountered for about 8-9 weeks of the year on average. At a lesser depth, 0-5 m, water at this low temperature may be encountered for

11-12 weeks. During some winters, temperatures can drop to only one-tenth of a degree, or a few tenths of a degree, above freezing point in shallow water. The report describes, in general terms the technical feasibility of heat abstraction in the vicinity of a number of larger urban areas around the lake, based on bottom topography and temperature.

31258 (BFR-R—143-1982) **Lake water heating systems. Seminar of the Council for Building Research, May 1982.** Billfalk, L. (ed.). (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1982. 198p. (In Swedish). (CONF-8205296—). NTIS (US Sales Only), PC A09/MF A01. File Number DE85750858.

From Aquatic energy meeting; Aelvkarleby, Sweden (5 May 1982).

The report presents an evaluation of the applications of the systems for the extraction of heat from and for heat storage in lake water. The evaluation was accomplished in the form of a meeting where about twenty lectures were given. Case stories concerning the utilization of heat pumps for sea and lake waters were presented together with legal and environmental aspects. A list of research projects and relevant publications are included in the proceedings.

31259 (BNL—51860) **Case study of the Brookhaven House.** Jones, R.F.; Loss, W.; Dennehy, G.; Ghaffari, H.T. (Brookhaven National Lab., Upton, NY (USA)). Sep 1984. Contract AC02-76CH00016. 80p. NTIS, PC A05/MF A01; GPO Dep. File Number DE85012573.

An evaluation is made of a passive solar house with a superinsulated shell. The building was constructed in 1979 at the Brookhaven National Laboratory. A Trombe wall and a sunspace wall collect and store solar energy during the day. The temperature-energy wave travels through the mass walls and heat is released to the inside of the building about 5 hours after peak solar irradiation. The tightly insulated envelope ensures that the heat accumulated in the house is not lost to the outside. Consequently, measured auxiliary heat requirements are very low, about 25% of a comparable conventional house in the region. In summer the house performs satisfactorily. Due to storage of night coolness temperatures in the living area are well below outside temperatures for most of the day. 11 refs., 35 figs., 16 tabs.

31260 (CONF-831204—, pp 285-293) **Energy conservation in existing small commercial buildings.** Freeman, E.C. (Dept. of Energy, Washington, DC). Jun 1984. Government Institutes, Inc., 966 Hungerford Dr., No. 24, Rockville, MD 20850. File Number TI84013400.

From 2. Mid-Atlantic energy conference and exposition; Baltimore, MD, USA (6 Dec 1983).

Research has recently been completed to characterize typical small commercial buildings existing in the United States and to assess the potential of retrofit measures to reduce energy use and peak electric demand. The focus has been on commercial buildings that will be eligible under the Commercial and Apartment Conservation Service Program mandated by Congress; i.e., with annual energy consumption less than 48,000 kWh of electricity and 12,000 therms of any other fuel. The physical and energy-use characteristics of typical commercial buildings, selected from a sample of 291 buildings in 9 cities, will be described. Estimated reductions in energy use and peak electric demand will then be presented for various building retrofit options to illustrate the potential for energy conservation in this class of buildings.

31261 (DOE/BP—439) **[Summaries of FY85 research in residential energy conservation].** (USDOE Bonneville Power Administration, Portland, OR. Office of Conservation). May 1985. 44p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85011782.

Technical studies, research and development projects are detailed on a number of conservation and renewable resource technologies for evaluation of their potential for electric power savings, costs, reliability, and availability. Programs cover: retrofit; new construction; state and local government assistance; consumer products and services; water heating; appliance efficiency; and environmental engineering for indoor air pollution abatement. A telephone directory is included. (PSB)

31262 (DOE/CS/22061—T1) **School and hospital energy conservation incentives.** Meyers, D.; Shrivastava, V. (Energy Resources Co., Inc., Vienna, VA (USA)). [1985]. Contract AM01-80CS22061. 23p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85012094.

The success of the Institutional Conservation Program will depend on the financial, economic, and institutional characteristics of schools and hospitals insofar as these factors influence energy conserving behavior. This paper explores these factors in an attempt to assist the ICP in reaching schools and hospitals. There are serious problems in both schools and hospitals with energy-conserving capital funding. Hospitals are discouraged from borrowing for this purpose by rate base regulation which limits their capital recovery. They are also unable to generate funds internally. Schools face no active disincentives for capital improvements but face a paucity of debt funding. Schools also have no means to generate funds internally. The major implications of these and other key findings for the ICP are as follows: In funding ECM's, the ICP is paying for improvements that might not otherwise have occurred, since both schools and hospitals are capital-poor; energy price decontrol hurts hospitals and schools, but tax breaks generated by the windfall profits tax do not help them; rate base regulation discourages energy conservation in hospitals if the ICP can exert some influence on hospital rating, its effectiveness would increase; and individual schools may be information-poor with regard to energy conservation. (The ICP therefore has a role to play in publicizing and organizing information for this sector).

31263 (DOE/R8/00437—T1) **[Methacrylates to form insulation]. Final technical report.** Rasmussen, L. (Rasmussen (Laurence), Nederland, CO (USA)). 20 May 1980. Contract FG48-79R800437. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85011342.

The use of methacrylates to form the interior foam of a transport insulation was studied. Problems encountered with the methacrylates include its low surface tension, and its slow rate of polymerization. An additional problem was an incompatability between the fluorinated surfactant molecules and the fluorocarbon gas used to blow the foam. Other experimentation involved acrylamide foams using glycerol-ethylene glycol combinations and sodium linolenate. Also investigated was the use of tin oxide coatings which are transported to visible light but reflect infrared light. (BCS)

31264 (DOE/SF/11629—T1) **Evaporative cooling workshop. Final technical report.** Mumma, S.A. (Arizona State Univ., Tempe (USA). Coll. of Architecture). 15 Jun 1982. Contract FG03-81SF11629. 64p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85013336.

With conventional refrigeration, room air is recirculated through the refrigeration unit. The air is chilled perhaps 20 degrees or more below room temperature and then blown into the rooms at low velocity and volume. This cold air mixes with the rest of the warm air in the room - cooling it without creating strong air currents. If you happen to stand directly in an air current from the unit, it will feel cold. With evaporative cooling, a large quantity of air cooled only a few degrees below average room temperature enters the house at a high velocity. Heat is picked up from objects in the rooms, but its temperature rises only a few degrees before it is expelled outside. Since it is near average room temperature, you can tolerate turbulent air currents without feeling chilly and benefit from the increased cooling of skin evaporation and convection. Evaporative cooling costs about one-quarter of the cost of electrical air conditioning. However, evaporative cooling may not be adequate on the hottest days, especially if the humidity of the outside air is high. Equipment for evaporative cooling is described and recommendations for installation are given. (LTN)

31265 (DOT-I—84-29) **Transportation energy management: energy efficiency in transit buildings.** (Municipality of Metropolitan Seattle-METRO, WA (USA)). Jan 1984. 75p. I. File Number TI85901496.

This report identifies three types of projects which help transit managers reduce energy bills: low cost projects, moderate cost projects and high cost projects. Low cost projects have capital expenses of less than $1000 and can be expected to reduce energy bills by 10 to 15% with a payback of less than one year. Examples include setback thermostats, delamping, and replacing lights which burn out with smaller wattage lights. Low cost projects are appropriate for implementation in all transit facilities. Moderate cost projects involve capital expenditures of $1000 to 20,000, and will have paybacks of less than 5 years. They include such measures as installing local light switches, converting to high efficiency lighting, and installing waste oil heaters. The moderate cost projects should be included in any facility expansion or rehabilitation. High cost projects have capital expenses of $20,000 or more. These projects require careful analysis, but they can reduce energy bills dramatically. Examples of high cost projects include lighting dimmer systems, heat recovery equipment, internal circulation and automatic doors, radiant heating, and energy management computers. These projects are excellent candidates for inclusion in UMTA facility construction grants. 17 refs.

31266 **(DTH-LV—121) Insulation and air tightness of six low-energy houses at Hjortekaer, Denmark.** Saxhof, B.; Aasbjerg Nielsen, A. (Danmarks Tekniske Hoejskole, Lyngby. Lab. for Varmeisolering). Nov 1982. 51p. NTIS (US Sales Only), PC A04/MF A01. File Number DE85750810.

LEP, the low-energy house project, The Danish Ministry of Energy. EFP.

In 1978-1979 six detached single-family houses were built at Hjortekaer, north of Copenhagen, as six different prototype low energy houses. In this report, a few typical construction details are described, some details having been chosen to illustrate solutions to the problem of cold bridges, others to demonstrate ways of obtaining airtight constructions. The infiltration air change rate has been measured a number of times by the tracer gas decay method, showing results ranging from 0.02 to 0.12 a.c.h. Also, pressurization and depressurization tests have been made - the results of these tests and the possible correlation with the air change rate are discussed. The total heat loss is worked out from the meter readings, allowing for the solar heat gain. The transmission heat loss (ranging from approx 70 to 155 W/C) is found by deducting the infiltration heat loss (mostly less than 10% of the total), and the result is compared to the calculated heat loss, based on the actual temperatures and the theoretical U-values. The calculated and the measured transmission heat loss differ less than 15%. By means of regression analysis of the thermal calibration data three different models for heat loss equations are tested.

31267 **(DTH-LV—156) Measurement of thermal comfort and discomfort.** Lund Madsen, T. (Danmarks Tekniske Hoejskole, Lyngby. Lab. for Varmeisolering). 1978. 24p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85750801.

From 1. international indoor climate symposium; Copenhagen (Denmark) (1978).

Comfort criteria have been discussed, which by measurement, form the basis for determination of the expected thermal comfort. The disadvantages of traditional measuring instrumentation are pointed out and a better method is suggested for determination of a person's expected degree of general thermal comfort. The lack of basis for a corresponding precise evaluation of the local comfort problems due to asymmetric radiation or draught is discussed. A couple of new parameters are given which, together with the existing knowledge, is deemed to give the best possible estimation or the degree of expected thermal discomfort due to assymetry of the thermal field. Finally, a new instrument is described which can analyse thermal environments as well as measure these new parameters.

31268 **(DTH-LV—159) New thermostat for increased thermal comfort and energy saving.** Lund Madsen, T. (Danmarks Tekniske Hoejskole, Lyngby. Lab. for Varmeisolering). 1983. 10p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85750800.

From 16. international congress of refrigeration; Paris (France) (1983).

During the last ten years an immense development has taken place within the area of indoor climate control. Computers are today used to control the temperature even in small buildings. However, the result in relation to thermal comfort and energy conservation is not always as good as expected. This paper deals with some probable reasons for this difference between expected and achieved result.

31269 **(DTH-LV—160) Comparison between operative and equivalent temperature under typical indoor conditions.** Madsen, T.L.; Olesen, B.W.; Kristensen, N.K. (Danmarks Tekniske Hoejskole, Lyngby. Lab. for Varmeisolering). 1984. 15p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85750802.

From American Society of Heating, Refrigerating, and Air-Conditioning Engineers meeting; Atlanta (USA) (Jan 1984).

In some of the new standards for thermal environments a certain operative temperature range is given as a requirement for the thermal environment. In other standards the requirement is given as an interval for the PMV-index. This index takes the activity level, clothing, air humidity and the equivalent temperature into account. In this paper it is discussed whether the operative temperature is satisfactory or the equivalent temperature should be used as a better expression because it also takes the air velocity into account. It is shown that the use of the equivalent temperature can save energy during summer conditions but also that it can be necessary to increase the temperature during winter conditions in order to keep the thermal comfort at an acceptable level.

31270 **(FRNC-TH—1882) Study and achievement of a data transmission system using low voltage AC line for residential heating centralized control.** Conil, J.P. (Institut National des Sciences Appliquees (INSA), 69 - Villeurbanne (France)). 1982. 193p. (In French). NTIS (US Sales Only), PC A09/MF A01. File Number DE85751590.

Assembleur; GOUPIL 2; 46 refs.

The major problem of centralized control for heating occurs at the information transfer level: transmission of room temperatures to the central controller and transmission of command signals from the controller to the heating devices. The transmission medium studied consists of low voltage electrical distribution lines, or mains line. The different transmission systems on the market and choice of the best adapted are reviewed. A comparison of two media is presented: heat tube and mains line. The system constructed is then described. Results of laboratory and in situ tests are finally given.

31271 **(LBL—17001) Comparison of measured and predicted infiltration using the LBL infiltration model.** Sherman, M.H.; Modera, M.P. (Lawrence Berkeley Lab., CA (USA)). Feb 1984. Contract AC03-76SF00098. 36p. (CONF-8404147—4). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85012549.

From ASTM symposium on measured air leakage performance of buildings; Philadelphia, PA, USA (2 Apr 1984).

The LBL infiltration model was developed in 1980; since that time many simultaneous measurements of infiltration and weather have been made allowing comparison of predictions with measured infiltration. This report presents the LBL model as it currently exists and summarizes infiltration measurements and corresponding predictions. These measurements include both long-term and short-term data taken in houses with climates ranging from the mild San Fransisco bay area to the more extreme mid-west. This data also provides a database for comparison with other infiltration models and provides a starting point for the determination of the accuracy and precision of air infiltration models. In this report we have presented the LBL infiltration model and have used field data to validate it. For short-term measurements the model predicts to within 20% for well defined environments (e.g. the MITU trailer) and slightly higher for other situations. The long-term (one week) average infiltration is accurate to 7%; in the Owens-Corning houses the long-term average error increases to up to 15%. A detailed examination of the LBL model using data from Mobile Infiltration Test Unit was used to probe the model and suggest areas for future research. 13 refs., 12 figs., 14 tabs.

31272 **(NMERDI—2-72-4618/1) Energy conservation code assessment. Volume 1. Final report.** Scheuch, K.E. (AREA, Inc., Albuquerque, NM (USA); Deringer Group, Albuquerque, NM (USA)). May 1985. 132p. NTIS, PC A07/MF A01 - NMERDI, Univ. of New Mexico, 457 Washington SE, Albuquerque, NM 87108. File Number DE85901564.

An assessment of the 1977 NM Energy Conservation Code was performed to identify changes which were cost effective in terms of life-cycle cost to the building owners. Suggestions were made to upgrade the residnetial sections of the code (apartments and multi-, single-family dwellings) to current practice (i.e., double pane windows, R-11 walls, and R-19 roof). For commercial buildings, it was recommended that a lighting power density be implemented at 2.0 Watts per square foot in office and retail structures. Implementation of the recommendations was estimated to save $4.75 million annually in utility costs over the present Code.

31273 **(NP—5750798) Comparison between the conventional and the inverted additional insulation of the flat roofs.** Christensen, G.; Prebensen, K.; Vesterloekke, M. (Cowiconsult Raadgivende Ingenioerer A/S, Virum (Denmark)). Oct 1984. 69p. (In Danish). NTIS (US Sales Only), PC A04/MF A01. File Number DE85750798.

A considerable percentage of all roofs in Denmark are flat roofs covered with roofing felt and as all other types of roof these flat roofs require periodic maintenance. In the conventional method of applying external additional insulation to flat roofs the insulating material is laid on the existing roofing felt, which then functions as vapour barrier, and then simply covered with new layers of roofing felt (the conventional roof). With the inverted roof the method of application is, as the name implies, vice versa. Here the insulation is laid on top of the existing roofing felt which, perhaps having required repair, now functions both as vapour barrier and as watertight membrane. As there is only limited experience with inverted roofs under Danish climatic conditions, it was found essential that a comparison be made between the conventional method of applying extra insulation, the conventional roof, and additional insulation applied in the form of the inverted roof. During the experiments, no substantial differences were found between thermal resistance in the conventional roofs and the inverted roofs without joints. On the basis of the tests carried out it is concluded that the inverted roof is considered suitable for Danish climatic conditions. However, calculations of thermal resistance for the inverted roof must take into consideration the reduced thermal resistance near the joints.

31274 **(NYSERDA—85-6) Research on modeling cogeneration-based residential energy systems in rowhouse and high-rise buildings. Final report.** Rodberg, L.; Jacobstein, N.; McNamara, M.; Shapiro, K.; Commoner, B. (Queens Coll., Flushing, NY (USA). Center for the Biology of Natural Systems). Sep 1984. 187p. New York State Energy Research and Development Authority, Two Rockefeller Plaza, Albany, NY 12223. File Number TI85901501.

A Residential Cogeneration Analysis program has been developed to describe the behavior of cogeneration-based energy systems in urban high-rise buildings and rowhouses. The Program identifies three cogeneration systems which might be installed in the user's building, operating in stand-alone, segregated-load, and utility back-up modes. Information is provided on energy consumption before and after the installation of these cogeneration systems, and a series of economic analyses is performed. Using the program, an analysis was performed of the effect of installing a cogeneration system in a 12-story, 48-unit apartment building in New York City. The most cost-effective mode of operation is the utility back-up mode, in which the cogenerator meets the base electrical and domestic hot water load of the building, with the utility grid providing additional electricity and the existing boiler meeting additional heating loads. In this mode of operation, the simple payback period is approximately two years. A conventional power plant converts only about one-third of the energy available from its fuel into electricity; the remaining two-thirds is not used, but is simply ejected into the atmosphere or nearby rivers. A cogenerator captures this heat for useful purposes, such as providing space heat or domestic hot water. As a result, a cogenerator can operate at an overall efficiency of 60% or better, compared with less than 33% for conventionally generated power. In recent years small cogeneration units suitable for use in residential buildings have become available. Such units can substantially reduce energy costs for the residents of high-rise apartment buildings or a set of adjoining rowhouses. CBNS has assembled data on all currently available cogeneration systems of capacity below 200 kilowatts, along with the heat recovery and electrical control equipment that would be used with these systems. 14 refs.

31275 **(ORNL/CON—122/R1) Buildings energy research: a bibliography.** Jordan, A.C.; Riordan, J.M. (Oak Ridge National Lab., TN (USA)). Apr 1985. Contract AC05-84OR21400. 647p. NTIS, PC A99/MF A01; GPO Dep. File Number DE85013550.

Publications of the Building Systems Division.

Buildings currently account for over one-third of the energy consumed in the United States. The Department of Energy's Building Systems Division (formerly the Buildings Division) has sponsored a variety of research programs designed to improve the energy performance of both new and existing buildings. This bibliography lists most of the documents generated from that research. Additional documents not sponsored directly by the Building Systems Division but bearing close relationships to its programs are also listed. The bibliography was created from a computerized bibliographic data base managed by the Oak Ridge National Laboratory's Conservation and Materials Group, a part of the Information Resources Organization. Abstracts and keywords are included for most of the documents. This bibliography was first published in April 1983. This updated version contains documents which have been generated since that time.

31276 **(ORNL/Sub—84-00240/1) Assessment of the energy savings potential of building foundations research.** Sterling, R.; Meixel, G.; Shen, L.; Labs, K.; Bligh, T. (Minnesota Univ., Minneapolis (USA); Undercurrent Design Research, New Haven, CT (USA); Massachusetts Inst. of Tech., Cambridge (USA)). Jan 1985. Contract AC05-84OR21400. 437p. NTIS, PC A19/MF A01; 1; GPO Dep. File Number DE85013549.

Building foundations are an important and integral part of the thermal envelope of buildings. In most buildings the proportion of the surface of a building in contact with the ground rather than the outside air is substantial. In housing this percentage may range from 45% for a one-story residence with a full basement to 25% for a two-story house with a slab on grade. For nonresidential buildings the percentage area of earth contact surfaces can also approach 45% for large one-story buildings and only becomes insignificant for large multistory buildings (without multiple basement levels). Since approximately 57% of all floor space existing in the United States is in single family detached houses and only 7% of nonresidential buildings have more than three stories, foundation heat transfer is clearly a major component of the thermal interaction of buildings with their environment. Possible energy savings for the residential building sector resulting from a change of foundation insulation from no insulation to a moderate level of slab perimeter or basement wall insulation are of the order of 0.40 to 0.46 quads or 0.5 to 0.6% of the US National Energy Consumption in 1984. The highest energy savings come from the northern and mid-state regions. The opportunity for energy conservation in building foundations is to capture as high a level as possible of the potential energy savings. This work cannot be restricted only to new construction if large savings are to be realized. About 450 refs.

31277 **(PB—85-155737/XAB) Preheat prediction models (revised).** Florez, J.; Barney, G.C. (University of Manchester Inst. of Science and Technology (UK). Control Systems Centre). May 1984. 38p. NTIS, PC E04/MF E04.

Revision of report dated January 84. See also PB84-232172.

Using semiempirically derived relationships between the time required to preheat the building before occupancy and the measured temperatures, self-tuning optimum start controllers are developed based on an adaptive predictor. Results obtained from simulations show that these controllers, and their variants, behave well and have superior performance characteristics compared with a conventional self-learning start-up controller. The controllers proposed assume no prior knowledge of the thermal characteristics of the building and are suitable for low-cost microcomputer implementation.

31278 **(PB—85-156008/XAB) Elimination of the outside influence in the prediction of optimum start control.** Florez, J.; Barney, G.C. (University of Manchester Inst. of Science and Technology (UK). Control Systems Centre). Jul 1984. 17p. NTIS, PC E03/MF E03.

Most preheat time controllers have the requirement to measure the outside temperature value for the evaluation of the optimum start time. An additional problem is that of finding the most representative location to sense the outside temperature. Simulation results presented in this paper show that when using self-tuning controllers, the outside temperature influence can be neglected without any great loss in the accuracy of the estimation of the preheat time.

31279 **(PB—85-157337/XAB) Review of development and application of heat-pump technology.** Johannsen, A. (National Mechanical Engineering Research Inst., Pretoria (South Africa). Heat Mechanics Div.). Jan 1984. 66p. (CSIR-RR—1832). NTIS, PC E04/MF E01.

North American Continent sales only.

A review is presented of the current state-of-the-art of heat-pump technology. Included is a discussion of basic heat-pump cycles, their practical implementation and the extent of the utilization of the different heat-pump systems in different countries. Trends in the current research and development of advanced heat-pump systems are also discussed. It appears that in South Africa, the most promising use of heat pumps is for water heating in medium to large installations, space heating in combination with air conditioning in commercial buildings, and heating and drying in industry. The establishment of a South African standard for testing heat pumps and launching of demonstration projects involving different heat pumps in different applications, is recommended.

31280 **(PB—85-158616/XAB) Energy-efficient residence (EER-2). Final report.** Luebs, D.F. (NAHB Research Foundation, Inc., Rockville, MD (USA)). Oct 1983. 122p. NTIS, PC A06/MF A01.

The energy-saving results are presented for the second all-electric energy-efficient residence to be built under a research and demonstration program sponsored by HUD. They show a total 1-year energy savings of more than $1,400 over that of a basic house of similar design without the extra features, with the greatest savings resulting from installation of an earth coupled heat pump and an extra insulation package. EER-2 was built in Damascus, Maryland to explore advanced measures for reducing energy consumption not now in common use but that might become practical within the next 5 to 10 years. EER-1 had shown how energy use could be reduced using conventional, readily available techniques. EER-2 was rented to a typical family and closely monitored for a full year to evaluate the effectiveness of its energy saving features. The total cost for operating the all-electric EER-2 house over the 1-year period was $657 based on a utility rate of $.053/kWh -- an average of only $54.78 a month. Of this toal cost, $115 was for heating, $55 was for cooling, $205 was for domestic water heating, $166 was for appliances, and $152 was for lighting and miscellaneous uses. The most significant savings occurred in the cost of space heating. The earth-coupled heat pump and extra insulation package, for an investment of only $4,950 combined, netted $1,121 savings in a single year.

31281 **(PB—85-158962/XAB) Production of selective optical coatings on plastic sheet. Final report.** Howson, R.P. (Commission of the European Communities, Luxembourg). [1985]. 94p. (EUR—9139-EN). NTIS, PC E05/MF E05.

A technique of vacuum deposition is described for producing heat-reflecting films onto sheet plastic for application in domestic windows. Thin-metal films of copper, silver, gold, and titanium nitride sandwiched between dielectric films and electrically conducting oxide coatings of indium, indium doped with tin, and cadmium/tin are shown to have the properties required for a heat-reflecting coating for visible windows. Durability measurements suggest that conducting oxide films have more promise. It should have a payback period of considerably less than one year, both in cost and in energy saved, and have the potential to be made in large areas to make a significant impact on natural energy use.

31282 **(PB—85-167336/XAB) CEL-1: conservation of electric lighting. Software.** Treado, S. (National Bureau of Standards, Washington, DC (USA). Center for Building Technology). 1 Oct 1984. vp. Source tape is in the ASCII character set. This restricts preparation to 9 track, one-half inch tape only. Identify recording mode by specifying density only. Call NTIS Computer Products if you have questions.

The CEL-1 (Conservation of Electric Lighting) computer program is a design and analysis tool for the design of building lighting-systems. It is capable of detailed simulation of lighting system performance, including the effects of daylighting. The interaction between the lighting system and the building heating and cooling systems is accomplished through a custom interface with the BLAST (Building Loads Analysis and System Thermodynamics) building energy analysis program. This tape contains the CEL-1 program Fortran Source files, data files and procedure files, including all updates and changes through 10/1/84. A major addition is the BLAST/CEL-1 interface routine. Software description: The model is written in the FORTRAN programming language for implementation on a CDC 760 computer using the NOS 1.4 Version 528 operating system. Memory requirement is 128 K bytes.

31283 **(PB—85-169126/XAB) Domestic market potential for solid-fuel burners. Final report.** (New Zealand Energy Research and Development Committee, Auckland). Apr 1984. 40p. (REPT—84). NTIS, PC E04/MF E01.

The objective of this study was to estimate the potential penetration level for solid-fuel burners in the domestic space and water-heating market in New Zealand. The term penetration level has been defined as the proportion of dwellings in New Zealand having a solid-fuel burner installed. Solid-fuel burners have been assumed to include all forms of solid-fuel-burning appliances apart from the simple traditional open fireplace.

31284 **(PB—85-169134/XAB) Demonstration of a hot-water-heater pump system. Final report.** Carrington, C.G.; Sandle, W.J.; Warrington, D.M. (New Zealand Energy Research and Development Committee, Auckland). Feb 1984. 55p. (REPT—102). NTIS, PC E04/MF E01.

The results of a practical demonstration of six heat pumps for saving energy in the heating of domestic hot water are presented. The units were monitored for six to twelve months in private homes in Dunedin and Auckland. The study showed that the electrical energy savings depended on climate and usage levels. The national average electricity use of the heat pumps was between 50-59% lower than conventional electric water heaters. The results established that the system maintained a good standard of hot water service, with some improvements occurring in the case of heavy consumers. A review of the available economic information on the heat pump water heater shows that the optimal level of installation nationally is critically dependent on the resource costs of the heat pump and of electricity, as well as other factors. Taking the value of electrical energy saved by the heat pump to be the marginal cost, it is shown that the heat pump will be economically competitive with expansions in the electrical generating system planned for the next ten to fifteen years.

31285 **(PB—85-170421/XAB) Duplex Stirling gas-fired heat pump. Phase 2. Breadboard demonstration. Final report, May 1981-November 1982.** Gedeon, D.; Penswick, B.; Beale, W. (Sunpower, Inc., Athens, OH (USA)). Nov 1982. 76p. NTIS, PC A05/MF A01.

This program represents the first attempt to design, fabricate, and test a breadboard gas-fired duplex Stirling heat pump in a heating only mode. The system was designed to obtain a COP of 1.5 at an ambient temperature of 17F and have an output sufficient for an average residential home. The design methodology, detailed system description and test results for sub components and the entire system are discussed. Technical problems encountered in the program, and recommendations for further efforts are detailed.

31286 (PB—85-180479/XAB) **Integration of building and energy technology with on-site waste management in the year 2000. Final report, October 1979-September 1980.** Deese, P.L.; Heschong, L.; Fuller, W. (Urban Systems Research and Engineering, Inc., Cambridge, MA (USA)). Mar 1985. 174p. NTIS, PC A08/MF A01.

During this study the potential feasibility of integrating waste management, water supply and on-site energy generation was examined with the objective of improving the objective of improving the overall resource efficiency of the typical residential unit. This report can be used by members of the various research and development communities to gain understanding of other fields and is meant to foster the appreciation of the interrelationships between residential utility systems.

31287 (PNL—5123, pp Intro 1-Intro 11) **Introduction.** May 1984. NTIS, PC A13/MF A01. File Number DE85003277.

In BEPS redesign of 168 commercial buildings: summary report.

Summary data from the Building Energy Performance Standards (BEPS) Phase II covers the Redesign experiment of 1978 and the related research on ASHRAE (American Society of Heating, Refrigerating, and Air Conditioning Engineers) Standard 90-75R conducted during 1978-79. The report includes eight articles describing a baseline for energy design elements, redesign strategies for office buildings and retail stories, energy strategies for high- and low rise multifamily dwellings, the complex relationships between sleeping rooms and service areas of hospitals and hotels, heat recovery, intermittent energy use, and conclusions about opportunities based on research on 168 buildings. Major divisions of the book cover analyses of each type of building.

31288 (PNL—5123, pp Intro 13-Intro 18) **Baseline for energy design.** May 1984. NTIS, PC A13/MF A01. File Number DE85003277.

In BEPS redesign of 168 commercial buildings: summary report.

An introduction to a series of articles reporting the findings of the largest research effort ever undertaken on building design, this article describes the energy-conscious redesign of 168 commercial and multi-family residential new buildings. The study set out to develop baseline data about the energy performance of new buildings, then to determine potential levels of energy reductions that could be achieved from this baseline. The results demonstrate that significant energy reductions are possible from design practice at only a small increase in average first cost. The research provided estimates of the energy behavior of a number of building types as well as some estimate of the impact of climate on each type. 6 figures.

31289 (PNL—5123, pp Intro 19-Intro 24) **168 proof?.** May 1984. NTIS, PC A13/MF A01. File Number DE85003277.

In BEPS redesign of 168 commercial buildings: summary report.

Part of DOE's Building Energy Performance Standards (BEPS) project was the energy redesign of 168 building designs in 13 building types. Because of similarities in usage patterns and functional space mix, highly individualistic buildings can be grouped into generic types. Awareness of the relative impact of how and when space is used and the use of design analysis tools to predict results is essential to appropriate design strategies. This article summarizes the findings for office, retail, and residency buildings in terms of the relative significance of the lighting, building systems, and the building's envelope, shape, and siting. As a result of BEPS research, energy use information now goes beyond abstract numbers to identify the actual architectural and mechanical design strategies responsible for substantial energy savings. 3 figures.

31290 (PNL—5123, pp vp) **Energy to recover.** May 1984. NTIS, PC A13/MF A01. File Number DE85003277.

In BEPS redesign of 168 commercial buildings: summary report.

Although the demanding environmental requirements of hospitals limit the use of conservation strategies that are viable in other building types, the researchers in the Building Energy Performance Standards (BEPS) project found that space conditioning and heat recovery strategies were dramatic keys to reducing energy use as much as 50% without compromising health care. The choice of architectural strategies influenced the buildings' form and reduced peak heating and cooling loads, but was not the predominant source of redesign energy savings. The major value of the hospital redesigns may be the demonstration that energy-efficient design is possible even under constrained circumstances. 4 figures.

31291 (PNL—5123, pp 5.a1-5.27) **Energy: a class by itself.** May 1984. NTIS, PC A13/MF A01. File Number DE85003277.

In BEPS redesign of 168 commercial buildings: summary report.

Redesign examples of 11 elementary and 11 secondary schools demonstrate how the energy aspects of conventional school construction could be improved. The intermittent usage patterns inherent in elementary and secondary schools resulted in redesign decision that often increased natural lighting while minimizing conductive gains and losses. Mechanical system controls for idle spaces were also important contributors to a higher than average redesign energy saving. The redesign experiment was part of the Building Energy Performance Standards (BEPS) redesign project. 4 figures.

31292 (PNL—5123, pp 2.a1-2.27) **Energy for sales.** May 1984. NTIS, PC A13/MF A01. File Number DE85003277.

In BEPS redesign of 168 commercial buildings: summary report.

The 19 redesigned retail buildings that were part of the Building Energy Performance Standards (BEPS) project differed in terms of size, merchandise sold, mix of functional spaces, and their role in the community. They ranged in size from a 7000 square foot chain bookstore to a 671,000 square foot regional shopping center. The 26% energy reduction achieved by the retail redesign teams over the original designs is significant, but not as substantial as in other building types. A wide range of constraints influenced each of the retail redesigns, so the designers concentrated on individual building component opportunities as opposed to strategies using whole building interactions. These were primarily lighting and space conditioning systems. 5 figures.

31293 (PNL—5123, pp 3.a1-3.a5) **Dwelling with energy.** May 1984. NTIS, PC A13/MF A01. File Number DE85003277.

In BEPS redesign of 168 commercial buildings: summary report.

There was little research on the energy efficiency of multifamily buildings until the Building Energy Performance Standards (BEPS) project redesigned 25 multi-family buildings ranging in size from 17,000 to 282,000 square feet in locations that are primarily in the cold and temperate zones. The buildings encompass rental apartment, condominium, housing for the elderly, and dormitory housing. The problems encountered in treating lighting systems, appliance usage, and domestic hot water in the redesign experiment highlight the difficulty of treating multi-family buildings as a commercial type when their 24-hour occupancy resembles residential buildings. Most of the redesign changes were architectural in nature. Strategies for siting, orientations, configuration, shading, and other envelope treatment are important. 3 figures.

31294 (PNL—5123, pp 3.a7-3.57) **Bed, board, and Btu's.** May 1984. NTIS, PC A13/MF A01. File Number DE85003277.

In BEPS redesign of 168 commercial buildings: summary report.

The diversity of nursing homes, motels, and hotels represents a continuum of increasingly complex relationships between sleeping rooms and service areas. Nonhousekeeping residential designs demand a spectrum of energy strategies to handle the internally load-dominated service areas and externally load-dominated sleeping rooms. The redesign activities of the Building Energy Performance Standards (BEPS) project achieved a 30-40% energy reduction in these types of buildings, primarily by reorganizing the building form, relocating functional spaces, and using more efficient building systems and insulation. 4 figures.

31295 **(SERI/TP—251-2648) Program redesign based on reality.** Potter, T.F. (Solar Energy Research Inst., Golden, CO (USA)). Feb 1985. Contract AC02-83CH10093. 8p. (CONF-8505135—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE85002937.

From 2. national utility energy efficiency conference; Oakland, CA, USA (21 May 1985).

From the perspectives of his previous position as a utility program developer/trainer and several later years of observation as program resource person at a federal lab, the author presents some quick sketches of the development of an early home energy audit program. Based on what he has learned from his experience, he makes a few suggestions for the design or redesign of current programs.

31296 **Evaluation of Minnesota utility home energy audit and retrofit loan programs.** Hirst, E.; Goeltz, R.; Thornsjo, M.; Sundin, D. (Oak Ridge National Lab., TN). *Energy Systems and Policy;* 9: No. 2, 171-195(1985). Contract W-7405-ENG-26.

Northern States Power (NSP), the largest utility in Minnesota, operates several residential energy conservation programs. This paper describes a detailed quantitative evaluation of two of these programs. The Minnesota Energy Conservation Service (MECS), Minnesota's version of the federal Residential Conservation Service, provides home energy audits and related services to eligible households. Between April 1981 and December 1982, NSP conducted almost 12,000 audits, covering 2% of its 580,000 customers eligible for the program. Loans are available to a portion of NSP's customers for installation of retrofit measures recommended in a MECS audit under NSP's Public Utility Conservation Investment Program (PUCIP). Between late 1981 and June 1982, about 450 PUCIP loans were made. 27 references, 2 figures, 6 tables.

31297 **Energy conservation to reduce summer cooling costs in Palm Springs.** Turner, R.H. (California Inst. of Technology, Jet Propulsion Lab., Pasadena, CA). pp 361-366 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

Various energy conservation techniques (ECTs) which can be retrofit installed on most houses to reduce summer cooling loads are evaluated from technical and economic criteria. Palm Springs represents one of the most severe summer climates in the United States and is chosen for study. The impacts of several ECTs are considered including: insulating stud walls, insulating window shutters, shading windows, installing double pane windows, and application of reflective tint film to windows. A methodology is developed to estimate the reduction in heat gain attributable to each ECT during the summer, and also winter performance, and to estimate the dollar value in terms of reduced air conditioning bills. The annual dollar benefit attributable to each ECT for different compass orientations is estimated for 1981 residential consumer energy prices. An economic Figure of Merit (FOM) is employed to allow ranking of the candidate ECTs.

31298 **The Energy-Efficient Home Project of Oregon.** Foute, S.J.; Havener, G.; Larsen, J.; Tabachnikov, A. (Energy Institute, Lakewood, CA). pp 339-344 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

The Energy-Efficient Home Project of Oregon was a joint public/private effort, involving mortgage investors, government agencies, professional associations, a lending institution, energy consultants and homebuilders in the design, construction and mortgage financing of sixteen moderately priced solar/energy conserving homes. The broad array of participants was brought together for a pilot project to demonstrate how an approach which encompasses the entire shelter industry can: create a favorable atmosphere and attractive investment vehicle for energy efficient residential construction; introduce new concepts such as a uniform energy rating system for homes and Energy Mortgage Valuation (EMV) in a context of the participants' typical business practices; result in homes built and sold; and prove in the marketplace the benefits of energy-efficient housing for all participants, from secondary mortgage market to homebuyer.

31299 **Inflatable structure in daylighting research.** Garvin, W.L. (Texas Tech Univ. Lubbock, TX). pp 153-156 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

The purpose of the proposed research project is to evaluate daylighting characteristics of a variety of window and skylight configurations useful in architectural design. The proposed studies will be quantitative in nature. The subjective nature of user responses to environmental conditions are equally important in terms of user satisfaction. The need to summarize both quantitative and qualitative data is recognized titative and qualitative data is recognized in the structure of this research. In examining natural lighting through the use of architectural models, the direct sunlight characteristics are readily simulated. Diffuse daylighting studies require the use of a heliodome configuration which is typically a costly, bulky structure with significant maintenance difficulties. This project examines the potential use of an inflatable fabric structure to examine the diffuse lighting characteristics of architectural models. It will compare the simulated and natural diffuse lighting of each prototype model as well as the direct and diffuse daylighting differences.

31300 **Indirect sunlighting and skylighting: Strategies used by Alvar Aalto.** Moore, F. (Miami Univ., Oxford, OH). pp 157-162 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

A conceptual framework is presented for designer understanding of daylight illumination strategies that utilize large white surfaces as light "sources". LUMINANCE x APPARENT SIZE is proposed as a simplified conceptual design framework. A series of strategies by the Finnish architect Alvar Aalto that employ white surfaces as light sources is discussed using photographs and matching line drawings from several libraries in Europe and the United States.

31301 **Daylighting analysis for an earth covered office building in Sacramento, California.** Boyer, L.L.; Roush, R.W. (Oklahoma State Univ., Stillwater, OK). pp 163-167 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

In order to assess daylighting performance and analyze anticipated energy savings during the design process, scale models were constructed to study three key areas: (1) typical light court, (2) subterranean commons, and (3) multilevel north-facing lightwell. Following completion of the building in late 1982, on-site measurement data were obtained to compare the actual results with those obtained through modeling during design. Site conditions, at the time measurements were taken, were very close to the minimum design sky assumed for the model studies. Although some configuration and surface treatment changes were made on the constructed building, a remarkable degree of correlation between actual and simulated building performance is clearly demonstrated. The performance measures include both actual lighting levels and distribution penetration patterns. Thus, energy savings anticipated from the validated model studies might be reasonably expected to occur during actual building operation as well.

31302 **Daylighting performance documentation of two innovative low rise commercial buildings.** Hallagan, W.; Simini, V. (Princeton Energy Group, Princeton, NJ). pp 401-406 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

Two low-rise commercial office schemes with design emphasis on daylighting have been documented in their ability to provide natural lighting. Illumination levels, surface luminance and auxiliary requirements of the spaces are presented. Parametric studies of design components are also presented.

31303 **Daylighting impacts of fenestration controls.** Ander, G.D.; Navvab, M. (California Energy Commission, Sacramento, CA). pp 175-180 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

The California Energy Commission under a legislative mandate established and periodically updates energy efficiency standards for new buildings. Performance standards in Btu/ft^2-yr as well as prescriptive standards are being developed. Daylighting impacts were calculated using Quicklite for typical office characteristics. Although Quicklite as well as manual calculations can be modified for horizontal shading devices (i.e., equivalent room concept), vertical fenestration controls such as fins can not be easily modelled. To access the daylighting impacts of commonly used fenestration control systems, physical model testing was conducted in the Sky Simulator at Lawrence Berkeley Laboratory. Four common control strategies were selected through recommendations from a Professional Advisory Group (PAG) representing the interests of the A I A, ASHRAE, IES, and other industry groups. These devices include vertical fins with two reflectances (/rho/ =.88, /rho/ =.67), an overhang and a light shelf design with clear glass above and heat absorbing glass below the light shelf. Each of these strategies were tested parametrically with scaled models. Solar altitudes were set at 30°, 50°, and 70°. Sky conditions also varied including both overcast and clear conditions to cover most of the variables impacting daylight performance.

31304 **The neglected half of commercial daylighting design reporting: Selecting the controls, fixtures, bulbs, and ballasts.** Aitken, D.W. (San Jose State Univ., San Jose, CA). pp 181-186 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

An overview is provided of those features of electric lighting controls, lighting fixtures, bulbs and ballasts that are of practical relavance to the daylighting designer. Particular emphasis is placed on daylight controlled dimming, and on the frequent practical necessity for limiting the amount of dimming to 50% or less in the interest of economy and of permitting the utilization of a wider spectrum of available illumination schemes and hardware. Advantages of the use of dimmers independent of the complementing of daylighting are stressed. The effectiveness of air-return ceiling-mounted luminaires on lighting fixture heat collection and on bulb luminosity is presented. The status of fluorescent bulb and ballast technology is briefly reviewed, and the matching of bulbs to ballasts and to dimmers is discussed. The importance of a working knowledge of these practical concepts by the designer is emphasized.

31305 **The impact of fenstration on energy use and peak loads in daylighted commercial buildings.** Selkowitz, S.; Choi, S.; Johnson, R.; Sullivan, R. (Lawrence Berkeley Lab., Univ. of California, Berkeley, CA). pp 187-192 of Progress in Passive Solar Energy Systems. Hayes, J.; Adrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

Effective utilization of daylight is one of several design strategies that promise to provide substantial energy savings for commercial buildings. Despite the revived interest in the field, there are very few occupied buildings for which performance data verify the magnitude and cause of real savings. In order to optimize costs it is first necessary to understand building performance in sufficient detail to assess the contradictory component impacts. This can be done most effectively using an hour-by-hour energy analysis model, in this case DOE-2.1B This paper reports conclusions of an extensive series of computer analyses in two climates to determine the energy use and demand impacts of fenestration in commercial buildings. Particular attention is paid to the tradeoffs involved in using fenestration to daylight perimeter zones. The study includes the effects of climate, orientation, window area, U-value, shading coefficient, visible transmittance, lighting power density, and lighting control strategy.

31306 **A review and analysis of 24 daylighting solutions.** Neubeck, K.M. (Arizona State Univ., Tempe, AZ). pp 199-204 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

Twenty-four daylighting models were designed and built by the graduate studio in energy conscious design at Arizona State University under the direction of Professor Jeffrey Cook. Each scale model represents a 9.1 x 12.2 m (30 x 40ft) office space. The models were displayed at the 1983 International Daylighting Conference; however, no documentation was presented. This paper explores the assumptions and specifics of each design in an effort to expand the library of daylighting designs available to architects and designers.

31307 **Interior design for office daylighting.** Guerin, D.A.; Mercer, R. (Miami Univ., Oxford, OH). pp 515-518 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

The performance of a daylit building can be jeopardized by inappropriate interior design. The interior designer must be supplied with surface light reflectance requirements, acoustic control information, and illumination distribution requirements in order to competently specify interior components and workstation layout. The following is a guideline for the interior designer of office spaces illuminated by daylighting.

31308 **Daylighting: A general economic and energy-saving analysis.** Busch, R.D.; Scheuch, K.E. (AREA Inc., Albuquerque, NM). pp 137-142 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

The energy and economic benefits available from daylighting depend upon several variables including glazing amount, glazing shading coefficient, and daylight penetration and level. In work performed for the California Energy Commission's Nonresidential Building Standards Development Project, AREA conducted an analysis of daylighting in office buildings to determine energy savings, economic benefits and life cycle costs. The goal of the analysis was to quantify the benefits and costs of daylighting within an office environment. Calculations were made for each of three California climate regions (Fresno, San Diego, and Oakland) with various shading coefficients and amounts of glazing. The results consist of a set of benefit-to-cost ratios for two different artificial lighting levels. Also presented are a series of graphs for three climate regions in California. Each graph displays building energy use as a function of shading coefficient, daylighting contribution, and amount of glass. These results can be used by the designer to evaluate energy and economic trade-offs for daylighting and glazing options in the preliminary phases of the design process.

31309 **Lens-guide viewing systems: An innovative use of daylighting at the University of New Mexico, School of Architecture and Planning.** Taschek, J.; Lusk, P.; Thomas, L. (Univ. of New Mexico Albuquerque, NM). pp 205-208 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

An optical, lens-guide viewing system has been constructed at the University of New Mexico, School of Architecture and Planning. Entirely passive, the system transmits a real time image of the Sandia Mountains through a series of lenses and mirrors into an interior design studio. The project design was modified from a system developed by M.A. Duguay and G.D. Aumiller of Bell Laboratories. The major problem to overcome was understanding the boundaries of the beam of light carrying the image in order to penetrate the building within the constraints of structure and existing use of space. Although the lens-guide concept did not originate at UNM, this project applies a natural lighting concept which has been largely ignored in solar design -- that of transmitting information. Lens-guides could be used in passive, inter-office visual communication systems, as windows providing psychologically needed contact with the outdoors, or for purposes as yet not conceived.

31310 **A graphical method for determining interflected daylight in clear climates.** Robbins, C.L.; Hunter, K.C. (Solar Energy Research Inst., Golden, CO). pp 131-136 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

This report presents an extension of the daylight factor method of analysis that includes a graphical method for determining interflected light in clear climates. The interflected component of daylight, called the internal reflectance component (IRC), has been determined for overcast skies in research performed in the United Kingdom. The technique developed by the Building Research Establishment in the United Kingdom is based on determining an average IRC for a given room or space. Using a daylight availability model developed at SERI (1), we established a similar average IRC analysis technique for clear skies. The results of applying the SERI daylight availability model suggest that a critical element in determining the IRC under clear sky conditions is the ratio of global to diffuse (G/d) illuminance on a horizontal surface. This graphical technique for determining clear sky IRC values is expected to enhance the accuracy of daylighting system design by simplifying the format used in clear sky computation.

31311 **Solar and internal gain adjustments in calculation of energy conservation savings.** Christensen, C.B. (Solar Energy Research Inst., Golden, CO). pp 111-116 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

Heating degree days are often used as a climatic measure in building energy calculations. To account for the effects of solar and internal gains, degree days at a lower base temperature are sometimes used, or the number of degree days is adjusted downward by a degree-day correction factor. In this paper, the authors present a theoretical derivation which demonstrates that ASHRAE C /sub d/ factors are not the appropriate correction factors for calculation of energy savings from envelope conservation measures. The results of this derivation can be used to develop new correction factors appropriate for savings calculations.

31312 **Development of an integrated daylighting design methodology.** Bryan, H.J. (MIT, Cambridge, MA). pp 147-152 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

This paper describes six daylighting calculation procedures that the author has been involved in developing over the last several years. They include: sky vault projection, tabular, graphic, protractor, programmable calculator, and microcomputer procedures. After analyzing each, the author finds that they all lack important qualities that would encourage their successful integration into the daylighting design process. A counter model is then proposed where the daylighting procedure becomes part of a learning experience which can integrate with the design process in a natural way and where the designer can exercise his of her knowledge and experience.

31313 **Application of modified degree day procedures to a residential rating system.** Michal, C.J.; Fuller, W.H. (EQUINOX, Inc. Peterborough, NH). pp 555-560 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

The authors have developed a residential energy efficiency labeling program for the Commonwealth of Pennsylvania. Users of the program determine energy efficiency using a printed brochure (known as the Home Energy Scorecard). This paper discusses the procedure used in the calculation of the major point values used to establish home scores. A projected 1,000 Btu of annual savings in energy demand was assigned a scorecard value of one "point." Points are achieved by substituting a given energy conserving technique (ECT) for uninsulated wall, ceiling, and floor construction or for the single glazing assumed for the reference case. Points determined for each ECT differ among seven house types and four climate zones. Points were also determined for ECTS involving infiltration control, passive solar heating, domestic hot water use and heating system equipment.

31314 **Educational tool for quick and accurate daylighting analysis.** Dwyer, L. (ENSAR Group, Lakewood, CA). pp 647-652 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

An educational/design tool using a microprocessor based, multiple-cell photometer has been developed by the ENSAR Group for the analysis of daylighting schemes in both physical models and actual buildings. Unique aspects of the system are its ability to produce instantaneous CRT display and hard copy graphic output which provide the student/ designer with quick feedback concerning the light distribution in the space. A physical model of a building design can be tested and then modified to learn the effects of any number of building parameters on the daylight level and distribution in the space. This is perhaps the most effective way to learn about daylighting design concepts because it instantly shows the cause and effect relationship between building design parameters and daylight levels. The system can also be programmed to act as a data-logger in order to monitor light levels over long periods of time (i.e., days or weeks) and store the data on magnetic tapes for later retrieval, plotting and analysis. This paper describes the ENSAR Daylighting Analysis System, as well as illustrating its application with an example design problem.

31315 **"Light Plenum" concept in office building design.** Mirkovich, D. (Washington State Univ., Pullman, WA). pp 168-174 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

Through the use of modelling, the "Light Plenum" concept was investigated to determine daylighting patterns in office building design. This concept is merely an extension of the light shelf application, or an enlargement of the conventional mechanical plenum to form a light trap. The trapped light reflected within the plenum is transmitted into the office space through a translucent ceiling pattern integrated with the electrical lighting system. Under sky conditions for the Pacific Northwest, the recorded results taken at

Pullman, Washington indicate that the translucent ceiling with daylighting controls will allow adequate, uniform task lighting levels. This daylight contribution for task lighting could allow a significant reduction in electrical lighting demands in office building design.

31316 **The effect of thermal mass in exterior walls on energy consumption in commercial buildings.** Wilcox, B.A.; Blyholder, A.G.; Gumerlock, A.; Mitchell, R. (Berkeley Solar Group, Berkeley, CA). pp 733-737 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

DOE2.1A building analysis of prototypical office buildings completed for the California Energy Code has shown that increased heat capacity of exterior walls allows equal annual energy performance with reduced thermal resistance. Based on this work, the California Energy Commission has adopted a set of prescriptive standards, in which the required insulation level depends on wall heat capacity. An optional package of conservation measures which allows uninsulated masonry walls by increasing ceiling insulation and reducing lighting energy is also presented.

31317 **The Wall Report- A "value insulation" approach to determining the cost effectiveness of residential wall construction.** Kaple, K.S.; Kidd, C.D. (Miami Univ., Oxford, OH). pp 749-753 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

This paper addresses many of the misconceptions associated with superinsulated walls and proposes a "value insulation" approach for determining the cost effectiveness of residential wall systems. The thesis of the paper is that homeowners, builders, and architects often do not clearly understand the benefits and total real costs of superinsulated wall construction. It becomes necessary therefore, to point out that "superinsulation" is not always "value insulation". "The Wall Report" was prepared by Miami University's Department of Architecture, in Oxford, Ohio. It provides some necessary background information on superinsulated construction, and a simplified worksheet procedure to analyze the cost effectiveness of various wall systems. Through the descriptions given for different wall framing approaches and the use of the worksheets, the most appropriate type of construction and the proper amount of insulation can easily be determined.

31318 **Ground temperature profiles for selected New Mexico locations.** Farrer, R.; Polka, R.; Selinfreund, M. (New Mexico Solar Energy Inst., Las Cruces, NM). pp 317-320 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

Earth-sheltering techniques can provide considerable savings in the energy used for the heating and cooling of buildings. These savings are due to the reduction in heat losses from earth-sheltered buildings in winter and to the reduction in heat gains to buildings in summer. To evaluate the potential thermal benefits due to earth sheltering, information about the variation of earth temperatures with depth (below the surface) and with the time of year is required for the proposed building location. Information of this nature is not currently available for locations in New Mexico. In this paper, an existing mathematical model for ground temperatures is used to generate predicted ground temperature profiles for selected New Mexico locations. Information on local temperatures (from existing long-term weather data) and local soil conditions is used in the model to predict ground temperatures as a function of depth and time of year. Predicted ground temperature profiles are compared with the few ground temperature measurements that are available.

31319 **Linear regression techniques in analysis of the Blouin superinsulated house.** Hagan, D.A.; Jones, R.F. (Brookhaven National Lab., Upton, NY). pp 259-264 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

Brookhaven National Laboratory, as part of its small building field validation program, gathered hourly data from the Blouin superinsulated house in South Royalton, Vermont, during March, April, and May, 1982. Least squares linear regression techniques came to be seen as one of the most valuable and powerful tools available for data analysis. Development of the models used and regression results obtained are presented for three major sub-systems of the house: the airto-air heat exchanger system, the window and insulating shutter assemblies, and the building envelope.

31320 **Energy-conscious design features for New California State Office Building - Site 1-C.** Bryan, H.; Bazjanac, V. (MIT, Cambridge, MA). pp 1023-1028 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Sociaty Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

This paper describes the energy-conscious features used in the design of a new 160,000 square foot California State Office Building (Site 1-C). The building represents an integration of a series of simple and proven energy-conscious design concepts that contribute to an extremely energy efficient end result. Covered are implications in building configuration, office space layout, fenestration and shading device design, and electric lighting/control alternatives. The various energy-conscious design features considered are discussed and particular solutions highlighted.

31321 **San Pasqual Battlefield State Historic Park- An Earthbound Visitors' Center.** Keniston, S. (Keniston & Mosher Architects, San Diego, CA). pp 1017-1021 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

The State of California for the last several years has actively supported the design and construction of particularly energy conscious buildings. This policy has been embraced by the State Parks and Recreation Department. Firms with backgrounds in "energy design" from throughout the state were interviewed for this project which had two basic requirements: 1. Design a culturally sensitive facility preserving archaeological sites within a 50+ acre tract and provide an interpretive display showing three cultures involved in an important historic battle. 2. Develop an energy program that would significantly reduce operation costs in an all-electric, inland valley near San Diego. This paper presents the generally more important overall design development issues as they relate to the energy program which culminated in an on-site budget of 8,500 Btu/ft^2/yr. Major features include earth integrated structure; wind scoops for venting; nocturnal cool-down; hybrid "breadbox" space heating; high-efficiency lighting (HPS and dimmable fluorescent); motion sensors; point-of-use and passive DHW; water conservation (ultra-low flush toilets-2 quarts and indigenous landscaping); and rammed earth walks and drive.

31322 **Daylighting, dimming & design.** Scully, D.V.; Fuller, W.H. (EQUINOX, Inc., Peterborough, NH). pp 971-976 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

Two EQUINOX, Inc. designed institutional classroom buildings have recently been built. In addition to super-insulation, the major energy conservation feature is perimeter and ridge line daylighting with automatic dimming of the lighting systems. The Swartley Music and Arts Center, Dwight-Englewood School, Englewood, NJ, is a 7,500 ft^2 renovation of an existing 2-story abandoned gymnasium building with a long quadruple-glazed "Kalwall" skylight providing high quality natural light to the second floor studios. A "Lutron" automatic dimming system is provided. The graphical daylighting design method developed at the University of Washington (Millett, M.S.) was used as a design tool. The New England Regional Wastewater Institute building, South Portland, ME, is a new 2-story 9,000 ft^2 classroom and laboratory addition. High and low perimeter double-glazed windows with intermittent skylights provide daylighting deep within the various classrooms. "Lutron" automatic dimming systems are provided for the classrooms and a site-built photoelectric dimming system is used to control the corridors and stairwell lighting. A 1/2 in. scale model and light meter, as well as the daylighting factor method using the QUICKLITE computer program was used in the design process. This paper discusses both buildings, the design process and the daylighting design tools used.

31323 **The Timberloft: A superinsulated house for cold climates.** Hansen, C.W.; Corbett, R.J. (Corbett/Hansen Assoc., Butte, MT). pp 915-920 of Progress in Passive Solar Energy Systems. Hayes, J.; Andrejko, D.A. New York, NY; American Solar Energy Society Inc. (1983). (CONF-830929—).

From 8. national passive solar conference; Santa Fe, NM, USA (5 Sep 1983).

As a logical extension of research in passive solar space heating technology, "superinsulation," (or, as William Shurcliff once suggested, "micro-load passive solar") is emerging as a simple, cost-effective building technology for cold-climate residential design. The transfer of superinsulation technology to the mainstream of new home construction requires detailed construction drawings for those building this type of housing for the first time. This paper presents and discusses the design rationale, significant architectural detailing, integration of an air-to-air heat exchanger system, and estimated construction costs of an architecturally attractive superinsulated house, the plans for which the authors are marketing by mail order. Computer simulations indicate that this house, if located in Great Falls, Montana, (7652 degree days) can be heated for $118. per year using electric heat at $.0295 per kWh.

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REFER ALSO TO CITATION(S) 29718, 31380

31324 (CONF-8009327—, pp 1-13) **Alternate fuels for maritime use.** 1980. Society of Naval Architects and Marine Engineers, 1 World Trade Center, Suite 1369, New York, NY 10048. File Number TI84009461.

From Shipboard energy conservation '80 symposium; New York, NY, USA (22 Sep 1980).

The Maritime Transportation Research Board of the National Academy of Sciences has completed a review of alternative fuels for the maritime industry. Twenty different fuels and energy sources were evaluated, with detailed consideration given to coal, coal/slurries, synfuels from coal, shale and tar sands, alcohols, and gases (methane and hydrogen). Application of these fuels were considered in diesel, steam and gas turbines for deep sea operations and for inland waterways. Wind and nuclear were considered as alternative energy forms. The fuels that have a high probability of commercial development for existing ships are synfuels from shale, coal or tar sands, while for new ships coal and coal/oil slurries are also possible candidates in addition to the synfuels. Coal is the primary alternate marine fuel and every effort should be made to implement its use.

31325 (CONF-8009327—, pp 15-45) **Re-engining of a VLCC with low-speed geared diesel engines.** Michiura, T.; Kozai, D.; Vragel, P. (Mitsui Engineering & Shipbuilding Co., Ltd., Tokyo, Japan). 1980. Society of Naval Architects and Marine Engineers, 1 World Trade Center, Suite 1369, New York, NY 10048. File Number TI84009461.

From Shipboard energy conservation '80 symposium; New York, NY, USA (22 Sep 1980).

The reengining of turbine powered VLCC's has in the past been accomplished using medium-speed geared diesel engines. The major reason for this is that medium-speed diesel engines of the required output range can normally be installed in existing engine rooms without involving substantial changes in the hull construction or the arrangement of auxiliary machinery and equipment. With the existing engine room arrangement of the Amoco Seafarer, it has been possible to incorporate slow speed diesel engines with lower fuel oil and lube oil consumption and lower maintenance costs than medium speed engines of equivalent output. The conversion of the Amoco Seafarer from steam to diesel will be carried out at Mitsui's Yura yard beginning in June, 1980. The design philosophy and principal technical details involved in the conversion are discussed.

31326 (CONF-8009327—, pp 47-71) **Ways to reduce slow steaming fuel consumption of steam turbine machinery through technical modifications.** Rein, H. (Det Norske Veritas, Oslo). 1980. Society of Naval Architects and Marine Engineers, 1 World Trade Center, Suite 1369, New York, NY 10048. File Number TI84009461.

From Shipboard energy conservation '80 symposium; New York, NY, USA (22 Sep 1980).

Over the past 5-6 years slow steaming has been a rather common mode of operation for a large number of ships, particularly ships with high propulsion power. The underlying cause of this has been a very large rise in bunker fuel prices since 1973-1974, while charter rates at the same time in general have stayed quite low. A study has been performed of some select configurations of steam turbine machinery to determine what fuel savings can be obtained, particularly at part load, through changes in method of operation or through technical modifications that for the most part are relatively moderate. Results are presented in the form of percentage fuel savings and in terms of cost savings. The savings may range from 0.5% to 10%. With fuel oil prices at its present high level, a fuel reduction of only 0.5% may represent a large annual cost saving well worth making an effort to achieve.

31327 (CONF-8009327—, pp 73-91) **Comprehensive program for shipboard energy conservation.** Sweeney, J.J. (Matson Navigation Co., San Francisco, CA). 1980. Society of Naval Architects and Marine Engineers, 1 World Trade Center, Suite 1369, New York, NY 10048. File Number TI84009461.

From Shipboard energy conservation '80 symposium; New York, NY, USA (22 Sep 1980).

One steamship line's successful energy conservation program is discussed. The development of a new staff position by senior management and the actual role of the energy conservation manager are explored in detail. Specific vessel design and operational deficiencies are described as discovered and corrected. A program of capital expenditures to reduce vessel fuel consumption, covering all aspects of both marine engineering and operations is then outlined. Bunker availability, price, and quality trends are reviewed and related to overall technical and economic considerations. Finally, the results of the first twelve months of this program are summarized and related to future benefits to be derived from studies presently in progress.

31328 (CONF-8009327—, pp 93-109) **Considerations in establishing a speed performance monitoring system for merchant ships - Part 1.** Logan, K.P.; Reid, R.E.; Williams, V.E. (Univ. of Illinois, Urbana). 1980. Society of Naval Architects and Marine Engineers, 1 World Trade Center, Suite 1369, New York, NY 10048. File Number TI84009461.

From Shipboard energy conservation '80 symposium; New York, NY, USA (22 Sep 1980).

The rapid escalation in the price of fuel oil and a substantial over-capacity in available tonnage of the world's merchant shipping have combined to cause a major problem in the maritime industry. Much effort has been devoted to improve efficiency of ship, bridge, and propulsion systems. The principal areas of fuel losses occurring during the operation of a ship in the open seas have been shown to be in the following four main areas: (1) power plant and auxiliaries, (2) propeller efficiency, (3) hull resistance, and (4) navigation and steering. Individual fuel savings credits for the various areas of losses have been shown to interact with one another when consideration is given to overall potential fuel savings achievable. Estimates of the increase in fuel consumption on poorly maintained ships, based admittedly on a relatively small sample of ships, have been placed in the range of 5 to 10% attributable to steam turbine power plant, 10 to 25% to hull and propeller degradation effects, and 5 to 10% from various other causes. The separation of these losses, one from the other so that remedial action may be taken is no small task. Identification of losses and their correlation with a particular effect has been shown to be achievable through the use of performance monitoring techniques. These techniques are described.

31329 (CONF-8009327—, pp 110-134) **Part II - techniques based on propeller relationships.** Logan, K.P.; Reid, R.E.; Williams, V.E. (Univ. of Illinois, Urbana). 1980. Society of Naval Architects and Marine Engineers, 1 World Trade Center, Suite 1369, New York, NY 10048. File Number TI84009461.

From Shipboard energy conservation '80 symposium; New York, NY, USA (22 Sep 1980).

Part I of the paper was directed to formulation of the problem of in-service speed performance measuring/monitoring of ships and development of a relatively simple onboard microcomputer based speed performance monitoring system using multiple regression techniques. Performance monitoring techniques based on the implicity propeller/propulsion relationships of the generalized power diagram are discussed in Part II. An examination of the accuracies of various methods of calculation of power correction using the relationships of the power diagram is carried out using service data for the Sea Barge Clipper S. S. Almeria Lykes for four voyages across the North Atlantic in the Spring and Summer of 1979. Based on these analyses and those resulting from the use of the statistical techniques of multiple regression and smoothing, an approach is taken to performance monitoring which attempts to combine these techniques using both model and trials data. An attempt to demonstrate how the several shortcomings of these various techniques can be overcome, hopefully, by development of an onboard speed loss identification system based on existing concepts is discussed.

31330 (CONF-8009327—, pp 135-150) **Monitoring speed and power for fuel economy.** Townsin, R.L.; Svensen, T. (Univ. of Newcastle upon Tyne, England). 1980. Society of Naval Architects and Marine Engineers, 1 World Trade Center, Suite 1369, New York, NY 10048. File Number TI84009461.

From Shipboard energy conservation '80 symposium; New York, NY, USA (22 Sep 1980).

General principles are outlined for monitoring the speed and power performance of ships in service. An example of monitoring is given to illustrate the method and value of applying the principles. The example compares the performance of two sister containerships for which speed power curves were measured during a round voyage. The difference between the two speed and power curves is related to the hull roughness. The energy expenditure per nautical mile is calculated for the two ships. It is shown that hull roughness costs the operator $6000 per annum per micrometre. Problems of monitoring performance using fuel figures are illustrated and the use of torsionmeters and satellite navigators is considered essential. The optimum speed of the ships is calculated.

31331 (CONF-8009327—, pp 151-166) **Some aspects of fuel economy in bulk carrier design and operation.** Scher, R.M.; Benford, H. (Univ. of Michigan, Ann Arbor). 1980. Society of Naval Architects and Marine Engineers, 1 World Trade Center, Suite 1369, New York, NY 10048. File Number TI84009461.

From Shipboard energy conservation '80 symposium; New York, NY, USA (22 Sep 1980).

Near-term solutions to the impact of higher fuel costs on the design of bulk carriers and strategies for fleet operation are discussed. Analytical techniques are proposed that recognize the inventory cost of the goods in transit as well as the economics of the ship itself. As an illustration of the proposals, the results of a study to determine the best combination of design speed and block coefficient for a bulk carrier of Panamax size under various levels of fuel price are shown. A section on fleet management proposes a method for selecting the most fuel-efficient plan for operating a fleet of ships during conditions fo fuel shortage or unforeseen rises in price.

31332 (CONF-8009327—, pp 167-181) **Energy conservation consideration in CVV hull form design.** McCallum, D.; Byers, D.; Fleming, J. (Naval Ship Engineering Center, Washington, DC). 1980. Society of Naval Architects and Marine Engineers, 1 World Trade Center, Suite 1369, New York, NY 10048. File Number TI84009461.

From Shipboard energy conservation '80 symposium; New York, NY, USA (22 Sep 1980).

As a result of the current energy shortage, the US Navy has been conscientiously examining various means to more efficiently use the available energy resources. Naval ships consume the equivalent of 78 million barrels of oil each year. During the recent design of a mid-sized, fossil-fueled aircraft carrier (CVV), the Naval Sea Systems Command (NAVSEA) used several new methodologies and techniques in order to design an energy efficient hull form. Model tests were performed with three different hulls, both with and without bulbous bows, and the powering data thus obtained were analyzed by computer on the basis of the ship's speed-time profile and specific fuel consumption data. The three hulls were comparatively evaluated using a rational hull form selection technique which addresses annual fuel costs in addition to traditional naval architectural considerations. It is shown that considerable savings in fuel costs can result from this approach.

31333 (CONF-8009327—, pp 181-198) **Prospect of sail-equipped motorship as assessed from experimental ship Daioh.** Ishihara, M.; Watanabe, T.; Shimizu, K.; Yoshimi, K.; Namura, H. (Nippon Kokan K.K., Tokyo, Japan). 1980. Society of Naval Architects and Marine Engineers, 1 World Trade Center, Suite 1369, New York, NY 10048. File Number TI84009461.

From Shipboard energy conservation '80 symposium; New York, NY, USA (22 Sep 1980).

An approach to the realization of a sail-equipped motorship is suggested based on the results obtained from wind tunnel tests, on-shore tests and sea trials of the experimental-ship Daioh conducted by the joint efforts of Nippon Kokan K.K. and the Japan Marine Machinery Development Association. Much technical data on sail performances was obtained through systematic wind tunnel tests. The sailing equipment was first mechanized to meet the various requirements, installed on board Daioh, and tested, and a power gain estimation method was verified by the sea trials. The economical aspects of a 10,000 ~ 35,000 DWT Bulk Carrier were also studied by utilizing the power gain estimation method. This then is a report on the successful termination of the first stage in the development process.

31334 (CONF-8009327—, pp 199-205) **Ship weather routing.** Dooley, A.L. (Oceanroutes, Inc., New York, NY). 1980. Society of Naval Architects and Marine Engineers, 1 World Trade Center, Suite 1369, New York, NY 10048. File Number TI84009461.

From Shipboard energy conservation '80 symposium; New York, NY, USA (22 Sep 1980).

Oceanrouting is the science of applying meteorological and oceanographic data to the transocean crossing of a specific ship by allowing the Master to take advantage of wind, sea, swell, and current conditions. The skills of marine weather forecasting and the principles of ship performance analysis has allowed the marine industry to reduce underway times for their ships while optimizing fuel usage and minimizing cargo and hull damages. In order for the techniques to be successful and show fuel savings, each ship must be given initial route recommendations, subsequent diversions, pertinent weather advisories, and performance evaluations of ship speeds. Some of the fundamentals of oceanrouting which must be applied in order to achieve the fuel conservation advantages of weather routing at sea are described.

31335 (CONF-8009327—, pp 207-217) **In-service roughness allowance: effects of drydocking, recoating and the passing of time.** Hamlin, N.A.; Sedat, R. (Webb Institute of Naval Architecture, Glen Cove, NY). 1980. Society of Naval Architects and Marine Engineers, 1 World Trade Center, Suite 1369, New York, NY 10048. File Number TI84009461.

From Shipboard energy conservation '80 symposium; New York, NY, USA (22 Sep 1980).

A historical survey is given of traditional methods used in predicting the performance of a new ship design on the basis of a correlation allowance and model tests together with a power margin. A method of logbook analysis is presented next, allowing one to find a service roughness allowance, directly analogous with the correlation allowance, by which one may assess the effect of fouling and surface degradation of the ship as time out of drydock passes. The logbook analysis is then applied to a break bulk ship over three drydocking cycles, and to a containership during one drydock cycle. The resulting service roughness allowance, and change in wake fraction, are then used to predict the smooth water performance of the ship in service, at any draft and power level.

31336 (CONF-8009327—, pp 219-241) **Hull roughness, antifouling coatings and ship performance.** Hartley, R.A. (International Paint Co., Inc., Union, NJ). 1980. Society of Naval Architects and Marine Engineers, 1 World Trade Center, Suite 1369, New York, NY 10048. File Number TI84009461.

From Shipboard energy conservation '80 symposium; New York, NY, USA (22 Sep 1980).

Hull roughness has an appreciable effect upon the flow of sea water over the underwater hull. Its relationship with skin friction and the boundary layer is briefly discussed. Hull roughness can be divided into micro and macro roughness factors; the former includes steel and paint profiles whilst the major component of the latter is biological fouling. Average hull roughness readings have been determined for a large number of vessels and the economic effects have been outlined. The performance of conventional antifouling paints shows serious limitations in expected life due to exponential decay in leaching rate and in the development of microroughness due to the leaching mechanism. In addition intercoat adhesion of subsequent costs of paint is generally poor leading to peeling and macro-roughness. The newly developed organotin copolymer antifoulings operate by a different mechanism with essentially a straight line leaching rate/time relationship, hence giving an appreciably longer life. In addition surface smoothing also occurs.

31337 (CONF-8009327—, pp 243-249) **Effectiveness of waterborne hull cleaning of aircraft carriers.** Hering, F.S. (Naval Air Station, San Diego, CA). 1980. Society of Naval Architects and Marine Engineers, 1 World Trade Center, Suite 1369, New York, NY 10048. File Number TI84009461.

From Shipboard energy conservation '80 symposium; New York, NY, USA (22 Sep 1980).

Headquarters Naval Air Force Pacific (COMNAVAIRPAC) has pursued an aggressive hull cleaning program since 1978 for the six aircraft carriers (CV) assigned. Extensive data has been taken based on ship's performance as well as on underwater hull and propeller inspection. Fouling rates for CV's operating in both warm and cold waters have been determined. Correlations of shaft horsepower vs. first stage turbine pressure and of fuel savings vs. speed are examined. Behavior of USS Midway in rapid refouling after cleaning is analyzed. A cost-effective cleaning interval for CV's has been determined and is considered along with other factors affecting the when to clean decision. A fuel savings of 15% over an entire five-year CV overhaul cycle is predicted. Comprehensive analysis of USS Ranger data is conducted, quantifying the benefits of cleaning and hull preservation. The data on Ranger also indicates that longitudinal trim may have a measurable impact on hull resistance and should be controlled when operationally practical. Observations of hull preservation and roughness of USS Constellationa nd her sister ship USS Kitty Hawk are discussed in light of consistently higher (approximately 14%) fuel consumption by USS Constellation, even with both ships in the clean hull condition.

31338 (CONF-8009327—, pp 251-279) **Marine steam power plant alternatives in the degrading fuel quality and increasing price environment.** Schroppe, J.T.; Niatis, U. (Foster Wheeler Boiler Corp., Livingston, NJ). 1980. Society of Naval Architects and Marine Engineers, 1 World Trade Center, Suite 1369, New York, NY 10048. File Number TI84009461.

From Shipboard energy conservation '80 symposium; New York, NY, USA (22 Sep 1980).

Residual oils, along with escalating prices, are progressively degrading in quality. This is occurring and will continue to occur due to increased demands on refineries for more distillants from a given barrel of crude oil. Degraded residual oils can be utilized by a steam propulsion plant. The present design marine boilers will accomplish this with slight increased maintenance and new boilers can be designed to maintain or lower present levels of maintenance. The various aspects of burning this degraded fuel are addressed, and design considerations for accommodation of this fuel for new construction are given. The present and future price of residual oil coupled to degradation of its quality introduces the alternate of coal burning which is viable from practical and economic considerations. Information on a coal burning boiler and a proposed plant is given. A comparison of the economics of this plant to an oil burning plant is made, plus a diesel plants fuel costs are given to emphasize the obvious cost advantage of coal.

31339 (CONF-8009327—, pp 281-295) **Coal-fired boilers for the 1980's.** Horlitz, C.F.; Sabo, S.E. (Combusion Engineering, Inc., Windsor, CT). 1980. Society of Naval Architects and Marine Engineers, 1 World Trade Center, Suite 1369, New York, NY 10048. File Number TI84009461.

From Shipboard energy conservation '80 symposium; New York, NY, USA (22 Sep 1980).

Since 1973, greater emphasis has been placed on the operating costs of vessels, particularly fuel costs. The rising prices of fuel oils have caused significant re-evaluation of the horsepower required for a given vessel. The availability of specific types and qualities of fuels is also of significant concern. An alternate fuel which is abundant and can be burned aboard ships is coal. A brief history of the development of marine boilers is presented, various method of firing coal are discussed, and a modern coal fired marine boiler and certain of its associated equipment are described. Also discussed are boiler design criteria that the boiler designer must consider when firing coal vs. oil.

31340 (CONF-8009327—, pp 297-315) **Design of coal-fired steam power plant for a containership.** Femenia, J. (SUNY Maritime College, Fort Schuyler, NY). 1980. Society of Naval Architects and Marine Engineers, 1 World Trade Center, Suite 1369, New York, NY 10048. File Number TI84009461.

From Shipboard energy conservation '80 symposium; New York, NY, USA (22 Sep 1980).

The design of four coal fired steam power plants including the required fuel storage and fuel handling systems was undertaken by the Marine Engineering Class of 1980 at the State University of New York Maritime College. The designs are based on the container ship version of the MarAd PD-214, Multi-Purpose Mobilization Ship. In addition to the summary of the system and component designs, a summary of the economic analysis is included. The conclusion drawn from the study was that modern coal fired ocean going merchant ships are technically and economically viable.

31341 (CONF-8009327—, pp 315-330) **Study of local roughness effect on ship resistance for effective cleaning and protection of hull surface.** Baba, E.; Tokunaga, K. (Mitsubishi Heavy Industries, Ltd., Nagasaki, Japan). 1980. Society of Naval Architects and Marine Engineers, 1 World Trade Center, Suite 1369, New York, NY 10048. File Number TI84009461.

From Shipboard energy conservation '80 symposium; New York, NY, USA (22 Sep 1980).

Protection of ship hull surface from fouling is one of the essential means to reduce the fuel oil consumption. For economical and effective cleaning and protection from fouling it is important to know the most effective location of hull surface in cleaning and protection with respect to reduction of ship resistance. In the present study, the resistance tests were made for a bulk carrier model and tanker models which were roughened artificially. The tests were made varying the roughened part systematically in lengthwise divisions. As a result it was found that the effect of the first quarter length of a ship is significantly larger (above 40%) among them. Some theoretical considerations which confirm the experimental results were made based on the turbulent boundary layer calculation for smooth and roughened hull surfaces.

31342 (CONF-8009327—, pp 331-342) **Propellers for economy.** Sinclair, L.; Eames, C.F.W. (Stone Manganese Marine, Ltd., London, England). 1980. Society of Naval Architects and Marine Engineers, 1 World Trade Center, Suite 1369, New York, NY 10048. File Number TI84009461.

From Shipboard energy conservation '80 symposium; New York, NY, USA (22 Sep 1980).

A marine propeller is normally designed to satisfy a number of often conflicting requirements and its efficiency, although important, has hitherto rarely been given highest priority. In the present circumstances when fuel prices and energy conservation are of paramount importance, it is believed that a re-appraisal of priorities is called for, placing emphasis on measures to improve the propulsive economy. Increased propeller efficiency can sometimes be achieved with significant gains, although in some cases a diminution of margins and provisions in relation to other aspects of performance may be involved. Although these remarks apply to the design of new ships, in the case of existing vessels, a much more cogent case can be made for improvement, as almost invariably ship's logs reveal that following years in service, the operating conditions are remote from from those for which the propeller was designed. Improvements of a significant order can be achieved and this is particularly the case if, for reasons of economy, an owner has decided to use a reduced operating speed. Advantage can also be taken at this stage of new propeller techniques, as the condition of the existing propeller may have deteriorated to some extent. The possibilities in relation to propulsive economy under the changing conditions are discussed.

31343 (CONF-8009327—, pp 343-360) **Evaluation of various types of nozzle propellers and reaction fin as the device for the improvement of propulsive performance of high block coefficient ships.** Takekuma, K. (Mitsubishi Heavy Industries, Ltd., Nagasaki, Japan). 1980. Society of Naval Architects and Marine Engineers, 1 World Trade Center, Suite 1369, New York, NY 10048. File Number TI84009461.

From Shipboard energy conservation '80 symposium; New York, NY, USA (22 Sep 1980).

Improvement of propulsive performance of ships has been considered to be one of the most effective items for power saving. In addition to the constant effort to design hull forms with better performance, various types of propulsion devices retrofitted to the existing ships have been considered to have promising improvement of ship propulsive performance. Experiments were made for VLCC models of different shapes of afterbody with the same kinds of propulsion devices, namely nozzle propellers including modifications and a reaction fin. Quantitative evaluations of each device with respect to propulsive performance were made. As a result it was found that the reaction fin is the most effective device among the retrofitting devices examined.

31344 (CONF-8009327—, pp 361-375) **Slurry fuels: the retrofittable alternative.** Winkler, M.F. (Seaworthy Engine Systems, Inc., Essex, CT). 1980. Society of Naval Architects and Marine Engineers, 1 World Trade Center, Suite 1369, New York, NY 10048. File Number TI84009461.

From Shipboard energy conservation '80 symposium; New York, NY, USA (22 Sep 1980).

With the uncertainty of supply and escalating fuel oil costs, serious consideration should be given to slurry fuel retrofits to reduce oil imports, reduce steamship operating costs, and to better use our natural resources. Slurry fuels remain to be the only viable, bunkerable and retrofittable fuel type for the existing steam fleet. While new ships can be most economically designed for direct coal burning, conversion to direct coal firing is not considered to be practical nor economically feasible. In order to bring marine slurry technology to a successful conclusion onboard existing vessels typical of modern design, three major areas of technical concern are: (1) shoreside processing, (2) onboard storage stability, and (3) satisfactory combustion related aspects. Use of as much of the vessel's existing tankage, fuel handling, and combustion systems minimizing extensive retrofit costs maximizes the economic gain that results from the use of such an alternate fuel. From limited laboratory and field test work it appears that shoreside processing plants can be built and properly sited, stabilization techniques can be practically applied, and complete carbon burn out can be achieved in boiler furnaces. This preliminary technical feasibility may join the economic attractiveness to make this category of marine fuel one of the best potential alternate fuels for this country's existing steam powered fleet of 500, or so, vessels.

31345 (CONF-8009327—, pp 377-390) **Prototype steam plant with fluid bed designed for uncertain energy conditions.** Albino, J.A.; Svensson, J.E. (Stal-Laval, Inc., Elmsford, NY). 1980. Society of Naval Architects and Marine Engineers, 1 World Trade Center, Suite 1369, New York, NY 10048. File Number TI84009461.

From Shipboard energy conservation '80 symposium; New York, NY, USA (22 Sep 1980).

The future availability, quality, and price of marine bunker fuels are extremely uncertain, and may involve economic risks far beyond the average business risk. The Very Advanced Propulsion (VAP) turbine plant has been developed with special consideration to this, aiming at low initial investment and low operational life cycle costs. It offers low fuel consumption, combined with the capability to burn cheap residual fuels, and keeps other fuel options open for the future. Some innovations are described, one of which is the application of fluid bed combustion. A five year test program has been completed including operation of a fluidized bed superheater installed at a Swedish power station during two winter heating seasons. The economic competitiveness of VAP is evaluated using ship life cycle study analysis with both oil and coal as fuel. These evaluations indicate a promising future for the burning of low quality fuel oil and a good prospect for burning coal as the full fluid fed is developed. This technology offers the possibility to improve the economy of existing ships by rebuilding existing turbine plants. The first VAP engine, which is considered a progression in steam propulsion machinery, is presently under manufacture, with new modularized components and auxiliary systems.

31346 (CONF-8009327—, pp 391-410) **Effective energy saving for motor ships.** Yokoyama, J.; Yamada, T. (Mitsubishi Heavy Industries Ltd., Tokyo, Japan). 1980. Society of Naval Architects and Marine Engineers, 1 World Trade Center, Suite 1369, New York, NY 10048. File Number TI84009461.

From Shipboard energy conservation '80 symposium; New York, NY, USA (22 Sep 1980).

After a comprehensive study on the feasibility of various kinds of working media including organic media, water has been finally selected as the most suitable working medium for Rankine cycle plant of waste heat recovery on board motor ships from a practical point of view. Hence, efforts to optimize the steam bottoming plant have led to the adoption of the duel steam pressure system, where the recovered electric power generation can be increased by 20 ~ 30% more than that of a conventional single steam pressure type system. The system is designed to recover the main engine exhaust gas heat solely in order to simplify the system configuration and operation. Seventeen (17) sets of the system have been completed by May, 1980 and are running satisfactorily at sea. In addition, thirty eight (38) sets are on order. Several other improvements are newly proposed to be added to the present system to make it more effective in energy-saving and widen its application.

31347 **(ORNL/TM—9608) DOE National Rideshare Program Plan.** Southworth, F. (Oak Ridge National Lab., TN (USA)). May 1985. Contract AC05-84OR21400. 86p. NTIS, PC A05/MF A01; GPO Dep. File Number DE85013543.

This document describes a three-year plan, as developed for the US DOE National Rideshare Program: a research and technology transfer program with the goal of encouraging more commuters to share their vehicles when traveling to and from work. The Plan is the result of an extensive nationwide review of current ridesharing benefits, barriers and activities, and describes an approach to: educating the nation's upper and middle management to the benefits of company-based carpooling and vanpooling, and to promoting the energy and financial benefits of capital investment in rideshare enhancing facilities. The Plan emphasized the means for collecting the information necessary to a successful rideshare marketing campaign, as well as the lines of communication through which the program's research findings will be disseminated.

31348 (PB—85-159838/XAB) Alternative technology for transit-bus air conditioning: the rotary-screw compressor. Final report 1981-82. Perez, D. (Department of Transportation, Cambridge, MA (USA). Transportation Systems Center). Nov 1984. 40p. (DOT-TSC-UMTA—84-29). NTIS, PC A03/MF A01.

This report summarizes the results of the test and evaluation of a prototype rotary-screw compressor design. The UMTA-funded RandD program consisted of two phases. The objectives of the first phase were to ascertain the extent of the problems with current bus air-conditioning systems and to determine the feasibility of adapting alternative compressor technology for use in transit buses. This work was carried out by the (Garrett) AiResearch Manufacturing Co. of Torrance, California and Dunham-Bush, Inc. of W. Hartford, Connecticut and has been documented in UMTA Report No. CA-06-0145-80-1 (NTIS No. PB-215-502). The second phase was to test a prototype alternative compressor under a wide range of simulated, and actual, bus revenue service environmental conditions and was also conducted by Dunham-Bush, Inc. It is the results of this effort that are documented in this report.

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REFER ALSO TO CITATION(S) 29614, 29615, 29647, 29676, 29677, 29678, 29679, 29680, 29681, 29682, 29683, 30081, 31372, 31822, 31828

31349 (AECL—8101) Rearing of fish and selected freshwater organisms in heated effluent. A Canadian perspective. McMahon, J.W. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). May 1983. 15p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85701473.

Utilization of waste heat emitted from thermal generating stations is shown to increase the winter growth rates, particularly of salmonids, from near zero to optimum without costly heating of water. A reasonable economic efficiency can be achieved at site specific stations, rearing fingerling rainbow or speckled trout to marketable size. For some consumer accepted species the technology at the international level is well ahead of its effective application. The present need is to transfer laboratory-scale research to pilot-scale units. High initial capital costs necessitate financial collaboration between the aquaculturist and the government.

31350 (BFR-R—10-1984) Industry's energy demand for space heating. Sahlin, C.; Nilsson, E.; Holmqvist, R.; Johansson, M.; Joensson, O. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1984. 146p. (In Swedish). NTIS (US Sales Only), PC A07/MF A01. File Number DE85750837.

24 various industrial branches are reporting their energy use. This survey of energy use for heating purposes points out the possiblities to recovering waste heat. Only 7 branches use more than 10 % of recovered heat for space heating. The branches which have been investigated are divided in three groups, namely such as using waste heat both from processes and space heating, those using waste heat from space heating and finally branches which are process intensive. The first group includes food and textile industry, chemical and rubber industries. The second group requires energetic ventilation and includes building materials, furniture and potteries. The share of space heating of the total energy use of the third group is negligible. In this branch we find sugar, pulps and cement as well as metal industries. The importance of finding out the chances to reduce the total cost of energy is indicated.

31351 (CONF-8406252—75) High temperature heat pumps for industry. Session 4 N.4.6. Hodgett, D.L.; Witt, J.A. (Union Internationale d'Electrothermie (Sweden)). 1984. 20p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85751763.

From 10. UIE congress on electroheat for improved economy; Stockholm, Sweden (18 Jun 1984).

The paper describes the possible types of applications for high temperature heat pumps and the technical options available for matching the heat pump to the industrial process. The criteria for the economic viability are explored and the target values for success are specified. The logic behind the search for the most appropriate applications in different industrial sectors is explained and the necessary efforts to achieve a successful transfer of technology are illustrated by the example of a high temperature heat pump for timber drying which is now in commercial operation.

31352 (DOE/CS/40091—T14) Energy conservation opportunities implemented by small and medium-size manufacturers. EADC Program, 1981-1983. Kirsch, F.W.; Deevy, L.M. (University City Science Center, Philadelphia, PA (USA)). May 1985. Contract AC01-78CS40091. 40p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85012979.

The 479 small and medium-size manufacturers served by the Energy Analysis and Diagnostic Center program during 1981-83 implemented 1782 energy conservation opportunities (ECOs) that had been identified in their plants. By doing so they were able to save over $11.25 million/year of their energy costs and to conserve more than 1822 billion Btu/year of their energy use. Those quantities represent 72.6% of the potential savings and 74.8% of the total conservation identified by the five EADCs that performed energy audits in these plants. This report presents the first overall analysis of the 1782 ECOs implemented, although previous reports have discussed portions of them. They are examined at different levels of detail, according to the energy sources involved, the categories of energy use affected, and the industries where they occurred.

31353 (DOE/CS/69096—18) Energy Management Manual for dairy processors. (Purdue Univ., Lafayette, IN (USA)). 1985. Contract FG02-80CS69096. 255p. NTIS, PC A12/MF A01; 1; GPO Dep. File Number DE85012313.

The Small Manufacturer and Food Processing Energy Management Program was an information development project focused on energy management for dairy processors. The goal was to improve the quality and relevance of energy conservation practices as they relate to production of dairy products in a manufacturing and processing plant. The information development involved two thrusts carried out concurrently: (1) Development and publication of an energy management manual to increase understanding of plant management, operation, and process personnel concerning energy conservation and management in dairy processing, and (2) Development of a series of computer programs to aid in the analysis of present plant performance and project alternate production processes and plant operation schemes. Use of the programs results in process schematics, an energy balance and a basis for cost estimates.

31354 (DOE/R1/21267—T1) Bypass filtration of cooling tower water: a demonstration project. (R.J. Industries, New Canaan, CT (USA)). [1985]. Contract FG41-81R121267. 20p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85013406.

R.J. Industries, Inc. under the DOE Appropriate Technology Program, designed, installed, and monitored a side stream water filtration system on a typical cooling tower arrangement supplying condenser water to refrigerated chilled water units. All of the components utilized in the filter system were readily available. (The actual filter unit was designed to maintain the clarity and overall quality of swimming pool water). R.J. Industries modified the flow characteristics and adapted the hardware for use with a cooling tower system. The application of existing equipment in a new technology proved to be a practical, cost effective approach for maintaining the quality of cooling tower water.

31355 (DOE/R2/05151—T1) **Building heat conservation and the feasibility of solar hot water heating in Long Island shellfish hatcheries.** Berg, D.L. (Berg (David L.), Miller Place, NY (USA)). [1980]. Contract FG42-80R205151. 81p. NTIS MF A01; 2; GPO Dep. File Number DE85013418.

Temperature regulation is a vital component of any aquaculture system. Existing facilities can be retrofitted with extra insulation, waste heat recovery systems and in some cases, active solar water heating. Those aquaculture ventures that seek to raise organisms to market size under controlled conditions are currently hindered by high operating costs, including fuel. These outfits can also benefit from conservation and alternative energy technologies. In addition, the industry may be more willing to cultivate species normally restricted by climatic conditions if a less expensive source of heating were available. This report focuses on three of the bivalve shellfish aquaculture enterprises of Long Island, New York. In the 1978 to 1979 growing season, Long Island shellfish growers collectively burned over 50,000 gallons of heating oil to warm their hatchery waters and buildings. Since then, heating oil prices have doubled. Currently, some growers are limited by these fuel costs from beginning production earlier in the season. In this report, several heat conservation measures are discussed, and the feasibility of active solar hot water is examined.

31356 (DOE/R3/06108—T1) **Energy self-sufficiency in the printing industry. Draft final report.** (Industry Consulting, Midlothian, VA (USA)). 1980. Contract FG43-79R306108. 206p. NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE85008467.

The Printing Industry ranks 15th out of the top 20 industries as regards energy consumption. It is now trying to incinerate its paper waste with heat recovery. Purpose of this study was to research and examine the feasibility and economics of the proposed energy recovery system, and to develop a preliminary design of such a system. A literature review was also conducted. Institutional considerations are reviewed. Potential impacts of the proposed energy recovery system include energy savings in oil/gas usage up to 0.2 to 0.36% of 1975 oil imports, volume reduction of solid wastes of 250:1, and avoidance of plant shutdowns. (DLC)

31357 (DOE/SF/10581—T1) **Small-scale regenerator. Final report.** (Thermo Energy Corp., Mountain View, CA (USA)). Jun 1981. Contract FG03-79SF10581. 72p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85013401.

Furnaces operating at 1900 F lose about 50% of the input energy in the exhaust gases. One method of saving energy is to recover the heat from the exhaust of the furnace and use that heat to preheat the combustion air to the burners of the furnace. A regenerator accomplishes this heat exchange by using the exhaust gas to heat a surface, moving that surface out of the exhaust gas stream into the incoming airstream and cooling the surface by the incoming airstream. Work was done on a design that used small stone media to transfer the heat from the furnace exhaust gas to the incoming burner air. A regenerator was designed to mate with a 1,500,000 Btu/h small industrial furnace, saving 44% of its fuel flow. A cold flow model was constructed to evaluate the flow of the stone media through the chambers of the regenerator. The hot regenerator was manufactured from high temperature stainless steel to withstand hot gas inlet temperatures up to 1900°F. In test, the regenerator demonstrated an effectiveness of 79% at 1150°F compared to its design value of 97% at 1850°F. Several modifications to the design of the hopper were evaluated to overcome this problem but none was successful.

31358 (DTH-LET-RE—84-3) **Effect calculation of a gas turbine with recirculating flue gas.** Frederiksen, P.; Qvale, B. (Danmarks Tekniske Hojskole, Lyngby. Lab. for Energiteknik). 1984. 51p. (In Danish). NTIS (US Sales Only), PC A04/MF A01. File Number DE85750809.

Calculations indicate that the effect of gas turbine power plants can be improved by utilization of flue gas heat for the purpose of the suction air heating. Heating of suction air can occur either by means of a heat exchanger or by direct mixing of flue gas and suction air. Combustion chamber tests prove that a gas turbine combustor can be operated with atmospheric oxygen concentration reduced to 15%.

31359 (EGG-M—13085) **Development requirements for advanced industrial heat pumps.** Chappell, R.N.; Priebe, S.J.; Bliem, C.J.; Mills, J.I. (USDOE Idaho Operations Office, Idaho Falls; Idaho National Engineering Lab., Idaho Falls (USA)). 1985. Contract AC07-76ID01570. 13p. (CONF-850515—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85012331.

From 7. annual industrial energy technology conference; Houston, TX, USA (13 May 1985).

DOE is attempting to advance the use of heat pumps to save energy in industrial processes. The approach has emphasized developing better heat pump technology and transferring that technology to the private sector. DOE requires that heat pump technology selected for development be both applicable to industrial processes and economically advantageous. To be applicable to industrial processes, heat pumps must be capable of temperature lifts and temperature operating ranges which are compatible with industrial processes. These two requirements for applicability appear to have more impact than all others. To be economically feasible, new technologies for pumping heat must have the potential to provide process heat at lower cost than can be provided by either alternative heat sources such as boilers or state-of-the-art heat pumps.

31360 (IS-EMRRI—19, pp 37-42) **Recovery of sulfur and lime from waste gypsum.** Kreischer, B.E.; Wheelock, T.D. Dec 1983. NTIS, PC A07/MF A01. File Number DE85011356.

In Iowa State Mining and Mineral Resources Research Institute. Final report, July 1, 1982-September 30, 1983.

Currently in the Iowa State University Chemical Engineering Department, development of a process to desulfurize gypsum (calcium sulfate) is underway. The process consists of a dual zone fluidized bed providing opposite reacting environments, self-contained within a single fluidized bed reactor. The lower zone provides a reducing atmosphere by incompletely combusting a fuel, such as natural gas or coal, while the upper zone is an oxidizing atmosphere. The reducing atmosphere is transformed into an oxidizing one by the addition of secondary air at some point higher up in the reactor. The main advantage in this dual zone systems lies in the very nature of a fluidized bed. The path that any one particle will follow will result in that particle experiencing each particular zone many times. This repeated exposure of the particles to the different zones will help circumvent the undesired production of calcium sulfide. This is accomplished through the subsequent oxidation of the calcium sulfide produced in the reducing zone. One important aspect of the further development of the ISU gypsum desulfurization process centers on the scale-up question. Any accurate economic feasibility study must include a reasonable estimate of the size of the fluidized bed reactor and the solids lost through entrainment.

31361 (IS-EMRRI—19, pp 91-102) **Utilization of coal-derived fly ash in combination with mining wastes.** Bergeson, K.L.; Pitt, J.M. Dec 1983. NTIS, PC A07/MF A01. File Number DE85011356.

In Iowa State Mining and Mineral Resources Research Institute. Final report, July 1, 1982-September 30, 1983.

Results of compressive strength screening and set time determinations, with the selection of chemical additives chosen, appear promising, relative to paste mixes at a water fly ash ratio of 0.24. At least two additives in each category of fly ash have shown an increased strength by a factor of 2 or more over that of the untreated controls. Initial setting time of the Neal No. 2 ash can be extended using some additives, by a factor of 3 or more without the loss of 28 day strength. Initial set time of the Neal No. 4 ash can be retarded by some additives ranging from 70 to 145 minutes. Strength loss at 28 days, however, ranges from 22 to 78 percent. Preliminary reaction product evaluation of Neal No. 4 fly ash treated with 3.0 percent ammonium phosphate indicate the glassy phase being dissolved and additional cementitious reaction products being formed. This preliminary evidence indicates that the mechanism for formation of the cementitious reaction products postulated may be valid.

31362 (PB—85-158897/XAB) Guide to packaged dehumidifiers. Brundrett, G.W. (Electricity Council Research Centre, Capenhurst (UK)). Oct 1984. 177p. (ECRC/M—1871). NTIS, PC E10/MF E10.

Almost two hundred packaged dehumidifiers are available for a wide range of specialist applications. Such dehumidifiers are unique in not only removing moisture but can also return the latent heat to the air and give a coefficient of performance in the heat-pump sense of 2. The application areas include curing condensation in housing, recovering energy in swimming pools, and drying industrial products. This Memorandum includes a comprehensive collection of data sheets from information supplied by the manufacturer. The Memorandum is intended as a Guide to the large and complex range of dehumidifier equipment on the market.

31363 (PB—85-165777/XAB) Barium and radium in water-treatment-plant wastes. Report for September 1983-May 1984. Snoeyink, V.L.; Jongeward, C.K.; Myers, A.G.; Richter, S.K. (Illinois Univ., Urbana (USA)). Feb 1985. 63p. NTIS, PC A04/MF A01.

Water treatment plants at nine locations (10 plants) in Illinois and Iowa were studied to determine the characteristics and disposal practices for the sludge, brine, and backwash water containing radium (Ra) and/or barium (Ba). The treatment processes in these ten plants include iron (Fe) and manganese (Mn) removal (3 plants), lime softening (4 plants), and ion exchange (3 plants). Eight plants had radium and three plants had barium. The data are needed to determine whether special procedures are required to dispose of such wastes.

31364 (PB—85-172575/XAB) Preliminary assessment of costs and credits for hazardous waste co-firing in industrial boilers. Final report, 1 July 83-15 oct 83. McCormick, R.; Weitzman, L. (Acurex Corp., Mountain View, CA (USA). Energy and Environmental Div.). Feb 1985. 64p. NTIS, PC A04/MF A01.

This report provides preliminary information on the costs and credits associated with hazardous waste co-firing in industrial boilers. The main objective is to identify and evaluate the costs/credits inherent in current hazardous waste co-firing practices, plus the additional costs that may be incurred as a result of more-stringent emissions limitations. An overview of current hazardous-waste/industrial-boiler co-firing practices is provided. This overview addresses the types of waste now being burned in boilers, the generic designs and capacities of boilers now being co-fired, and the types of air pollution control device (APCD) retrofits that may be required in the advent of air-emissions regulations. Parametric cost-estimate methods are provided for: (1) waste-handling-equipment addition, (2) combustion-system retrofit, (3) APCD retrofit, (4) incremental OandM costs, and (5) fuel savings and waste-disposal credits. The cost-estimating approach is designed to account for differences in waste characteristics, boiler design, capacity, and waste/fuel co-firing ratio. Finally, cost/credit calculations are presented for two hypothetical waste co-firing scenarios. These calculations are presented to illustrate how the information provided in this report can be used; no conclusions concerning the economy of waste co-firing are intended.

31365 (PB—85-174910/XAB) Centralized ladle preheating system. Final report, March 1982-February 1984. Battles, B.E.; Battles, D.D. (Thermecon, Atlanta, GA (USA)). Jun 1984. 62p. NTIS, PC A04/MF A01.

See also PB85-101467.

Ladle preheating in metals production is an energy-intensive process and is usually done inefficiently. A successful ladle preheating system for large-scale applications (ladle of 50 to 500 tons capacity) has been developed. This system uses a heat exchanger and sealed heating thus minimizing losses. Because of equipment costs, identical systems cannot be economically scaled down for ladles under 50 tons. However it is possible to centralize some functions of a multiple heating station thus reducing capital costs. A single heat exchanger, combustion air blower, and control subsystem can be shared by several heaters. The scope of this project is to produce such a design. The development of this technology will allow foundries and small-scale steel mills to reduce their energy cost for ladle preheating. It may also convince operators to implement an energy saving gas fired system where no heating was previously being used.

31366 (PB—85-177111/XAB) Using mined space for long-term retention of nonradioactive hazardous waste. Volume 1. Conventional mines. Final report, August 1983-January 1985. Stone, R.B.; Moran, T.R.; Weyand, L.W.; Sparkman, C.U. (Fenix and Scisson, Inc., Tulsa, OK (USA)). Mar 1985. 108p. NTIS, PC A06/MF A01.

See also PB85-177129.

This two-volume report assesses the current status of using mined space for long-term retention of nonradioactive hazardous waste. Volume 1 updates previous studies conducted in 1974 and 1975 and examines published literature, determines involvement of government agencies, reviews regulatory and permitting requirements, and identifies existing mines for a potential demonstration project.

31367 (PB—85-177129/XAB) Using mined space for long-term retention of nonradioactive hazardous waste. Volume 2. Solution-mined salt caverns. Final report, August 1983-January 1985. Stone, R.B.; Covell, K.A.; Weyand, L.W. (Fenix and Scisson, Inc., Tulsa, OK (USA)). Mar 1985. 66p. NTIS, PC A04/MF A01.

See also PB85-177111.

This two-volume report assesses the current status of using mined-space for long-term retention of nonradioactive hazardous waste. Volume 2 expands the definition of mined space to include that created by solution mining of salt. This report examines the extent of salt deposits in the continental United States, relates the salt deposits to waste-generating regions, examines the variances in salt chemistry for the various deposits, describes the methods for creating solution-mined caverns, discusses design and operation considerations, discusses projects proposed by industry, discusses advantages of the concept, and discusses needed research.

31368 (PB—85-185890/XAB) Bench-scale process evaluation of reburning and sorbent injection for in-furnace NOx/SOx reduction. Final report, October 1983-October 1984. Greene, S.B.; Chen, S.L.; Clark, W.D.; Heap, M.P.; Pershing, D.W. (Energy and Environmental Research Corp., Irvine, CA (USA)). Mar 1985. 256p. NTIS, PC A12/MF A01.

The report gives results of combining reburning with the injection of calcium-based sorbents to investigate the potential for combined NOx and SOx reduction. Reburning, applied to pulverized-coal-fired utility boilers, involves injecting a secondary fuel above the main firing zone to produce a reducing zone where NOx is converted to molecular nitrogen. Overfire air is added above the reburn reducing zone to complete the combustion. Bench-scale evaluations of reburning, carried out in a plug-flow furnace at 23 kWt, have indicated that NOx reductions of up to 70% can be achieved depending on a number of process variables, dominant of which are the initial NOx level that is to be reduced, the reburning fuel type (pulverized coal type or natural gas), and the stoichiometry, residence time, and temperature in the reducing zone. Combining the two processes indicates that the optimum sorbent injection location in a reburning system is with the burnout air because of the increased reactivity of the calcined sorbent. Dolomite consistently produces higher capture than calcitic limestone for a wide spectrum of combustion conditions. It is possible to relate sulfur capture directly to sorbent reactivity as characterized by surface area after calcination. Sulfur capture in a coal-fired system is similar to that obtained with doped propane. Sulfur capture is most dependent on injection temperature.

31369 (PNL—5466) Survey of US Department of Defense Manufacturing Technology Program activities applicable to civilian manufacturing industries. Final report. Azimi, S.A.; Conrad, J.L.; Reed, J.E. (Energetics, Inc., Columbia, MD (USA)). Mar 1985. Contract AC06-76RL01830. 222p. NTIS, PC A10/MF A01; GPO Dep. File Number DE85012249.

Intent of the survey was to identify and characterize activities potentially applicable to improving energy efficiency and overall productivity in the civilian manufacturing industries. The civilian industries emphasized were the general manufacturing industries (including fabricated metals, glass, machinery, paper, plastic, textile, and transportation equipment manufacturing) and the primary metals industries (including primary aluminum, copper, steel, and zinc production). The principal steps in the survey were to: develop overview taxonomies of the general manufacturing and primary metals industries as well as specific industry taxonomies; identify needs and opportunities for improving process energy efficiency and productivity in the industries included; identify federal programs, capabilities, and special technical expertise that might be relevant to industry's needs and opportunities; contact federal laboratories/facilities, through visits and other forms of inquiry; prepare formatted profiles (descriptions) potentially applicable work efforts; review findings with industry; and compile and evaluate industry responses.

31370 **(PNL—5512) User manual for Conservation Project Data Base.** Garrett-Price, B.A.; Fassbender, L.L. (Pacific Northwest Labs., Richland, WA (USA)). Jun 1985. Contract AC06-76RL01830. 100p. NTIS, PC A05/MF A01; GPO Dep. File Number DE85013806.

This User Manual describes the Conservation Project Data Base developed by the Pacific Northwest Laboratory for the Department of Energy's Office of Conservation (CE). Purpose of this data base is to provide a centralized storehouse of information on planned and ongoing projects funded by CE. The data base is a powerful analytical tool that will enable CE to quickly analyze the composition of their project portfolio. The data base uses dBase III on an IBM PC. Over 80 data items are stored for each project. A menu-driven applications program was developed as an alternative to using standard dBase III commands. The menu-driven program prompts the user to add data, edit data, perform on-screen searches of the data base, sort the data base by any variable or combination of variables, or print hard-copy reports of various data items.

3206 Municipalities And Community Systems

REFER ALSO TO CITATION(S) 30560, 31048, 31255, 31286, 31296

31371 **(AD-A—150181/6/XAB) Reliability, availability, and maintainability of the heat-recovery incinerator at Naval Station Mayport. Final report, October 1981-March 1983.** Zimmerle, J. (Naval Civil Engineering Lab., Port Hueneme, CA (USA)). Oct 1984. 101p. (NCEL-TN—1708). NTIS, PC A06/MF A01.

The heat recovery incinerator (HRI) at Naval Station Mayport, Fla. was studied to determine the expected long-term performance of the HRI. The data, which were collected from October 1980 to August 1983, were analyzed for reliability, availability, maintainability, waste incineration rate, thermal efficiency, and steam cost. Actual results for incinerating waste to produce steam were: reliability 58% (75% of design); availability 82% (91% of goal); maintainability 0.10 man-hr/ton (100% of goal); thermal efficiency 48% (87% of goal); incineration rate 1.75 tons/hr (105% of goal); and cost of steam $6.05/MBtu. The HRI was expected to save $26,600/yr from landfill reductions and $102,320/yr from energy savings. The principal reasons for the shortfalls in performance were shortages of solid waste, and failures in the crane, feed rams, ash conveyor, front-end loader, feedwater equipment, and induced draft (I.D.) fan. Corrections have been made in HRI operation to improve performance of the ash conveyor. Recommendations are made on additional maintenance procedures, and on equipment design criteria to improve plant operation and for future plant design.

31372 **(AD-A—152236/6/XAB) Heat-recovery incineration: a summary of operational experience. Final report.** Ducey, R.A.; Joncich, D.M.; Griggs, K.L.; Sias, S.R. (Army Construction Engineering Research Lab., Champaign, IL (USA)). Mar 1985. 19p. (CERL-SR-E—85/06). NTIS, PC A02/MF A01.

This report summarizes the results of a study to determine how reliably heat-recovery incinerators (HRIs) are performing in the field. Information on equipment used, operating parameters, economic factors, and problems encountered in operating HRIs was provided by 52 installations throughout the United States. Twenty of the most common problems experienced with HRIs in the field are discussed. In each case, the percentage of installations experiencing each problem is also provided. Military personnel can use this information to evaluate HRIs for military applications. Overall, the majority of HRIs users were found to be generally satisfied with the performance of their systems. However, they indicated that efficiency could be improved and the amount of maintenance reduced. The most appropriate HRI must be chosen on a site-specific basis. It has been noted that the most successful applications have been at installations which thoroughly researched their waste supply and steam demands before project design, chose the HRI manufacturer carefully, and properly trained their operators.

31373 **(BFR-R—58-1983) Heat recovery from sewage effluent by heat pumps for supply to the Enkoeping district heating system. A feasibility study.** Svensson, T.; Wahlberg, H.; Wahlberg, O. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1983. 59p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. File Number DE85750854.

This feasibility study describes a general model for economic sizing of additional energy production units in a district heating plant. The model can be used even if other energy sources are already in use. All costs have been expressed as function of the thermal output power of the energy production plant for optimization purposes. Differentiation with respect to power indicates the economic optimum installation. This economic model has been used for calculating the optimum size of heat pump to be used by the Enkoeping District Heating Company for recovery of heat from purified sewage effluent. Calculations have allowed for both daily and annual variations in effluent flow. Existing production plant is based on oil, coal and wood chip fuels. In the light of favourable Swedish electricity tariffs, only electrically driven heat pumps have been considered. The results indicate that the economic optimum size of heat pump is about 5 MW, producing a calculated internal interest rate of 24 percent. A semi-empirical calculation procedure has been used to analyse changes in ice cover if the temperature of sewage effluent is reduced by the heat pump. The results indicate that there would be only marginal effects on the thickness of ice cover.

31374 **(DOE/SF/01948—T1) Covered, anaerobic, wastewater lagoon primary treatment system, the "anaerobic cell". Technical completion report.** Alsten, C.; Stewart, W. (Solar AquaSystems, Inc., Encinitas, CA (USA)). 10 Apr 1980. Contract FG03-78SF01948. 108p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE85013407.

Progress achieved during the period covered in the grant is presented. Supporting documents including progress reports are included. The purpose of this project has been to study the operational characteristics of a covered, anaerobic, primary lagoon developed by Solar AquaSystems called the "Anaerobic Aquacell" (ANA) as a domestic wastewater treatment system for the reduction of BOD, suspended solids, nutrients, heavy metals and toxic materials and the production of methane as an energy product. The process is an aquaculturally derived wastewater treatment system which integrates proven wastewater treatment elements to allow greater process control, higher quality effluent, and reduced land area as compared to conventional wastewater lagoons. Three AquaCell pond systems, anaerobic, facultative, and aerobic, all containing high surface area bio-film devices, can be used in series to achieve primary, secondary and/or advanced treatment, respectively. Three years of pilot scale demonstrations have shown that conservative design practices can be used while also achieving reduced construction, operation and maintenance costs, minimal solids handling, low energy demand, and low operator skill requirements. The use of a multiple series of controlled cells allows a high degree of design and operational flexibility for meeting various effluent quality objectives. The City of Hercules, California, Solar AquaCell Treatment System is also described.

31375 **(PB—85-156941/XAB) Theory, design, and operation of nutrient-removal activated-sludge processes.** (Johannesburg City Council (South Africa); Cape Town Univ. (South Africa); National Inst. for Water Research, Pretoria (South Africa)). 1984. 218p. NTIS, PC E10/MF E01.

Errata sheet inserted. Prepared in cooperation with Cape Town Univ. (South Africa), and National Inst. for Water Research, Pretoria (South Africa). Sponsored by Water Research Commission, Pretoria (South Africa).

Caution should be exercised when selecting an unbiodegradable particulate COD fraction (f(sub up): social organization of the community for whom the wastewater treatment process is envisaged must be critically examined. For example, analyses of data reported by Sutton et al. (1979) from Canada, indicate that the (f(sub up) fraction is 0,25 for raw wastewater. Such a high value probably arises from the use of garbage grinders. A similarly high (f(sub up) is used in the design procedure followed by Black and Veatch (1979) (based on McKinney's activated sludge model) which includes an unbiodegradable organic material fraction which is equivalent to an (f(sub up) value of 0,23. Wastewaters with high (f(sub up) fractionswill result in greater sludge production than those with low fractions and selecting too low a value will result in underdesign of the treatment process and sludge disposal facilities. This demonstrates the pitfalls in selecting wastewater characteristics uncritically and without recognition of the factors which contribute to their nature and composition. It also demonstrates the dangers of applying uncritically, technology developed overseas to local conditions and vice versa.

31376 **(PB—85-167245/XAB) Technology assessment of sequencing batch reactors.** Irvine, R.L. (Notre Dame Univ., IN (USA). Dept. of Civil Engineering). Feb 1985. 82p. NTIS, PC A05/MF A01.

The innovative and alternative technology provisions of the Clean Water Act of 1977 (PL 95-217) provide financial incentives to communities which use wastewater treatment alternatives that reduce costs of energy consumption over conventional systems. Some of these technologies have been only recently developed and are not in widespread use in this country. In an effort to increase awareness of the potential benefits of such alternatives and to encourage their implementation where applicable, the Municipal Environmental Research Laboratory has initiated this series of Emerging Technology Assessment reports. This document discusses the applicability and economic feasibility of utilizing sequencing batch reactors as a viable alternative to conventional continuous-flow activated-sludge facilities for the treatment of municipal wastewater.

3209 Education And Public Relations

REFER ALSO TO CITATION(S) 30445, 30447, 30451, 31314

31377 **(ORNL—6142) Factors that influence the implementation of energy-saving technologies at Naval shore facilities.** Brown, M.A.; Jones, D.W. (Oak Ridge National Lab., TN (USA)). Apr 1985. Contract AC05-84OR21400. 75p. NTIS, PC A04/MF A01; GPO Dep. File Number DE85012059.

The purpose of this report is to assist the Naval Civil Engineering Laboratory by identifying important factors that influence the adoption and continued use of energy conserving technologies at Naval shore facilities. Results of site visits and a survey of decision makers at Naval shore facilities in the southeastern United States suggest that a significant barrier to adoption of new energy-conserving technology is the shortage of personnel to install, operate, and maintain new equipment. This situation enforces energy use patterns which may appear excessive, but which may be appropriate choices when guided by conditions of local manpower scarcities combined with the ability to draw on additional funds to cover unpaid fuel bills. A contributing problem is that only a small proportion of energy consumption activities are metered and many existing meters go unread. The inability to identify excessive energy users and to verify energy savings inhibits effective modifications of behavioral patterns and the introduction of new equpment.

31378 **(PB—85-158277/XAB) Neighborhood energy works.** (Technology and Economics, Inc., Cambridge, MA (USA)). 2 Mar 1982. 206p. NTIS, PC A10/MF A01.

This resource tool for neighborhood groups planning to start or expand an energy conservation program offers useful information on organizational techniques and practices as well as energy conservation and production technologies. The opening chapters on community project organizing, public relations, financing, and program marketing detail the procedures for starting and expanding a neighborhood organization. Each explains the techniques and resources available to organize, administer, publicize, finance, and sell the energy program. A chapter on energy technologies contains three major sections. The first section discusses appropriate technology that permits the designing of energy projects to match the skills and resources of a particular organization with the energy conservation and economic development needs of the targeted neighborhoods. The second section contains information on energy conservation measures applicable to residential and commerical buildings, while the last section outlines renewable resource technologies, both active and passive, which may be used effectively in the energy programs. The resource directory provided is a five-part listing of energy-related resources: (1) a reference guide listing publications, periodicals, and audiovisual materials; (2) national energy information sources; (3) national energy organizations; (4) government agencies; and (5) a listing of State energy extension services and State energy offices. The appendix contains detailed case studies of nine neighborhood organizations involved in energy conservation and production programs.

33 ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

3301 Internal Combustion Engines

REFER ALSO TO CITATION(S) 29796, 29797, 31125, 32056

31379 (CONF-831142—, pp i-iv) **Welcome and program overview.** Chesnes, A.A. (Dept. of Energy, Washington, DC). Mar 1984. NTIS, PC A18/MF A01. File Number DE85000072.

From Automotive technology development contractor coordination meeting; Dearborn, MI, USA (13 Nov 1983).

An overview of the Department of Energy's Automotive Technology Development Program is presented. The program continues to follow the guidelines established by the National Energy Policy Plan of 1981 and focuses on proof-of-concept type development, long-term high-risk technology barriers, and more generic research with wide applications. The total budget for FY1983 for these activities was $39.5 million or about the same as for FY1982. The program efforts continue to show excellent progress with all major projects essentially on schedule, are meeting or surpassing goals and objectives, and remain within established budgets.

31380 (CONF-831142—, pp v-vii) **Keynote address (Automotive Technology Development Program).** Collins, W.P. (Dept. of Energy, Washington, DC). Mar 1984. NTIS, PC A18/MF A01. File Number DE85000072.

From Automotive technology development contractor coordination meeting; Dearborn, MI, USA (13 Nov 1983).

Industry successes as well as the accomplishments of the US DOE in the Automotive Technology Development Program are discussed. The US DOE believes in conservation as a part of a comprehensive and balanced energy policy because the transportation sector currently uses nearly 27% of the total energy consumed in the US and transportation claims 61% of all petroleum consumed in this country. Achievements in the field of transportation energy efficiency can significantly contribute to the future security and prosperity of the US.

31381 (CONF-831142—, pp 99-100) **Heavy duty transport technology project overview.** Davidson, H.W. (NASA Lewis Research Center, Cleveland, OH). Mar 1984. NTIS, PC A18/MF A01. File Number DE85000072.

From Automotive technology development contractor coordination meeting; Dearborn, MI, USA (13 Nov 1983).

The DOE/NASA Heavy Duty Transport Technology Program initiated in 1981 is managed by NASA Lewis Research Center. The program has a primary objective to provide a technology base for industry to use in developing advanced heavy duty transport engines. The project focuses on adiabatic diesel engines for long-haul trucks because of their potential for fuel savings when used in this sector of the transportation industry. The term adiabatic diesel engine refers to any class of diesel engines which incorporate insulated walls of the chambers enclosing the working fluid in an attempt to improve engine efficiency. Industry ideas and participation in this project are encouraged through the use of Applications Notices (AN's). To date about ninety unsolicited proposals have been received in response to the two AN's issued in February 1982. About twenty contracts or grants were awarded in the five key technology areas. These areas are component technology, materials, waste heat utilization, tribology, and systems. Each of these areas is briefly discussed.

31382 (CONF-831142—, pp 101-106) **Development of future performance maintenance and cost requirements for heavy duty diesel engines.** Strawhorn, L.W.; Suski, V.A. (American Trucking Associations, Washington, DC). Mar 1984. NTIS, PC A18/MF A01. File Number DE85000072.

From Automotive technology development contractor coordination meeting; Dearborn, MI, USA (13 Nov 1983).

Developers of advanced heavy duty diesel engines are engaged in probing the opportunities presented by new materials and techniques. This process is technology driven. But there is neither assurance that the eventual users of the engines produced by this process will be comfortable with them nor indeed that the users will be around in either the same form, or the same numbers they are today. The equipment development process must have more user input to ensure maximum payoff of research dollars. An approach to generating this input, defining user concerns, cost tolerances, and defining engine parameters that would match future projected industry needs was developed. The approach is explained and results gathered to date are presented.

31383 (CONF-831142—, pp 107-120) **Investigation of enhanced thermal barrier coating systems for diesel engine components.** Schechter, B. (GM Corp., Indianapolis, IN). Mar 1984. NTIS, PC A18/MF A01. File Number DE85000072.

From Automotive technology development contractor coordination meeting; Dearborn, MI, USA (13 Nov 1983).

Results to date of investigations of thermal barrier coating systems for diesel engine components are presented. These coating systems employ a plasma sprayed layer of partially stabilized zirconia on a metal substrate. In some cases, a strain isolator is used as an intermediate layer between the coating and the substrate. Several measured system thermal conductivity values are presented as well as a discussion of additional tests to follow in completing the investigation.

31384 (CONF-831142—, pp 121-134) **Cummins/TACOM advanced adiabatic engine.** Kamo, R.; Bryzik, W. (Cummins Engine Company, Inc., Columbus, IN). Mar 1984. NTIS, PC A18/MF A01. File Number DE85000072.

From Automotive technology development contractor coordination meeting; Dearborn, MI, USA (13 Nov 1983).

Cummins Engine Company, Inc., and the US Army have been jointly developing an adiabatic turbocompound engine during the last nine years. Although progress in the early years was slow, recent developments in the field of advanced ceramics have made it possible to make steady progress. It is now possible to reconsider the temperature limitation imposed on current heat engines and its subsequent influence on higher engine efficiency when using an exhaust energy utilization system. An adiabatic turbocompound diesel engine concept is presented in which high performance ceramics are used in its design. The adiabatic turbocompound engine will enable higher operating temperatures, reduced heat loss, and higher exhaust energy recovery, resulting in higher thermal engine efficiency. The careful selection of ceramics in engine design is essential. Adiabatic engine material requirements are defined and the possible ceramic materials which will satisfy these requirements are identified. Examples in design considerations of engine components are illustrated. In addition to these important points, the use of ceramic coatings is described in the design of engine components. The first generation adiabatic engine with ceramic coatings is described. The advanced adiabatic engine with minimum friction features utilizing ceramics is also presented. The advanced ceramic turbocharger turbine rotor as well as the oilless ceramic bearing design is described. Finally, the current status of the advanced adiabatic engine program culminating in the AA750 V-8 adiabatic engine is presented.

31385 (CONF-831142—, pp 135-140) **Advanced automotive diesel assessment program.** Sekar, R.; Kamo, R. (Cummins Engine Company, Inc., Columbus, IN). Mar 1984. NTIS, PC A18/MF A01. File Number DE85000072.

From Automotive technology development contractor coordination meeting; Dearborn, MI, USA (13 Nov 1983).

The results of the feasibility study completed by Cummins Engine Company to identify an advanced automotive diesel (AAD) engine for passenger car applications are outlined. The study resulted in the definition of an adiabatic diesel engine with several novel features. The predicted fuel economy of a 3000-pound AAD powered car is 78.8 MPG on a combined metro-highway route. This compares with a current production diesel powered car yielding 37.7 MPG. All other critical features of the AAD, such as emissions, noise, driveability, cost, durability, etc. are comparable to current products on the market. The problem areas such as NOx emissions, initial cost, etc. appear to be amenable to solution. Four long lead time technology areas needing experimental verification are discussed.

31386 (CONF-831142—, pp 141-148) **Exhaust-driven Brayton Bottoming Systems for adiabatic diesel engines.** Khalifa, H.E. (United Technologies Research Center, East Hartford, CT). Mar 1984. NTIS, PC A18/MF A01. File Number DE85000072.

From Automotive technology development contractor coordination meeting; Dearborn, MI, USA (13 Nov 1983).

An evaluation of Brayton Bottoming Systems (BBS) as waste heat recovery devices for future adiabatic diesel engines in heavy duty trucks is presented. Parametric studies were performed to evaluate the influence of external and internal design parameters on BBS performance. Conceptual design and trade-off studies were undertaken to estimate the optimum configuration, size and cost of major hardware components. The potential annual fuel savings of long-haul trucks equipped with BBS were estimated. It is shown that the BBS could effect about 12% of annual fuel savings and would cost about $170/Bhp. It is also shown that, when properly integrated with a turbocharged adiabatic engine, the BBS would offer a 3.3 years simple payback relative to the aftercooled, turbocompound version of the same engine.

31387 (CONF-831142—, pp 149-154) **Steam bottoming cycle study for heavy duty transport.** Demler, R.L.; Hug, H.A.; Krepchin, I.P.; Poulin, E.C.; Walker, D.H. Mar 1984. NTIS, PC A18/MF A01. File Number DE85000072.

From Automotive technology development contractor coordination meeting; Dearborn, MI, USA (13 Nov 1983).

A DOE/NASA sponsored study of steam bottoming cycles using diesel engine exhaust heat projected substantial performance and economic benefits for long haul trucks. A state-of-the-art reciprocating expander steam system was ultimately selected for conceptual design and economic assessment. This 1000 psia 1000°F simple cycle represents the combined operational experience of perhaps 10,000 steam engine hours at these conditions accumulated by several R and D firms in this field.

31388 (CONF-831142—, pp 155-168) **Status report for an RC-1 organic Rankine bottoming cycle for an adiabatic diesel engine.** Koplow, M.D.; DiNanno, L.R.; DiBella, F.A. (Thermo Electron Corp., Waltham, MA). Mar 1984. NTIS, PC A18/MF A01. File Number DE85000072.

From Automotive technology development contractor coordination meeting; Dearborn, MI, USA (13 Nov 1983).

A system analysis and preliminary design was conducted for an organic Rankine-cycle system to bottom the high-temperature waste heat of an adiabatic diesel engine. The bottoming cycle is a compact package that includes a cylindrical air-cooled condenser-regenerator module and other unique features. The bottoming cycle output is 56 horsepower at design point conditions when compounding the reference 317 horsepower turbo-charged (TC) diesel engine with a resulting brake specific fuel consumption (BSFC) of 0.268 lb/hp-hr for the compound engine. This system for Heavy Duty Transport applications uses the organic working fluid RC-1, which is a mixture of 60 mol % pentafluorobenzene (PFB) and 40 mol % hexafluorobenzene (HFB). Included in these 1983 work efforts was the thermal stability testing of the RC-1 organic fluid in a dynamic fluid test loop that simulates the operation of a Rankine cycle. To date, more than 1300 hours of operation have been completed with results showing that the RC-1 is thermally stable at 900°F.

31389 (CONF-831142—, pp 183-192) **Time-temperature dependence of the strength of commercial zirconia ceramics.** Schioler, L.J.; Quinn, G.D.; Katz, R.N. (Army Materials and Mechanics Research Center, Watertown, MA). Mar 1984. NTIS, PC A18/MF A01. File Number DE85000072. Contract AI01-77CS51017.

From Automotive technology development contractor coordination meeting; Dearborn, MI, USA (13 Nov 1983).

The unusual combination of attractive properties exhibited by transformation toughened zirconias (TTZ's) has focused attention on them as leading candidates for application in the adiabatic diesel engine. These materials are age-hardened ceramic alloy systems and as such they are likely to be susceptible to overaging and loss of strength at long times at high temperatures. Preliminary data are presented on the microstructural, phase and dimensional stability of aged TTZ's together with some data on the effects of aging on strength, toughness and modulus. Stress rupture data on TTZ's with both MgO and Y_2O_3 additions show a considerable decrease in load carrying ability at temperatures of 800°C and above.

31390 (CONF-831142—, pp 193-200) **Long-term stability and properties of commercial zirconia ceramics.** Larsen, D.C.; Adams, J.W. (IIT Research Institute, Chicago, IL). Mar 1984. NTIS, PC A18/MF A01. File Number DE85000072.

From Automotive technology development contractor coordination meeting; Dearborn, MI, USA (13 Nov 1983).

The physical, mechanical, and thermal properties of transformation-toughened zirconia ceramics can vary widely, depending on initial particle size, concentration of alloying oxide used, processing time-temperature schedule, and post-fabrication heat treatment and surface preparation. The goal of this program is to determine the properties and long-term stability of such materials that are currently being developed by the ceramics industry. Previously, five foreign and domestic commercially available zirconia ceramics were characterized. Investigated were crystal phases, stabilization, microstructure, thermal expansion, strength, elastic modulus, and fracture mode with respect to transformation-toughening, phase stability, and overaging phenomena. Future work will address material behavior before and after long-term exposure in static oxidizing atmosphere. The central issue in this program is the stability of the tetragonal zirconia crystal phase; i.e., the phenomenon of overaging upon extended thermal exposure, and resultant loss of toughness.

31391 (CONF-831142—, pp 207-214) **Transformation toughening in the Al_2O_3-Cr_2O_3/ZrO_2-HfO_2 system.** Brog, T.K.; Jones, J.W.; Tien, T.Y. (Univ. of Michigan, Ann Arbor). Mar 1984. NTIS, PC A18/MF A01. File Number DE85000072.

From Automotive technology development contractor coordination meeting; Dearborn, MI, USA (13 Nov 1983).

Strength and fracture toughness have been studied at room temperature for the (Al_2O_3 - XCr_2O_3) + 15 v/O (ZrO_2 + $YHfO_2$) systems for Cr_2O_3 contents ranging from 0-30 mole % in Al_2O_3 and HfO_2 contents ranging from 0-30 mole % in ZrO_2. Preliminary results indicate that bend strength is more strongly influenced by processing defects than composition. It was found that fracture toughness increased with increasing Cr_2O_3 and HfO_2 additions. Further work is required to elucidate the mechanisms of toughening and the effect of composition and particle size.

31392 (CONF-831142—, pp 215-222) **Transformation toughening of ceramics for engines.** Musikant, S.; Rauch, H.W. Sr.; Feingold, E. (General Electric Co., Cincinnati, OH). Mar 1984. NTIS, PC A18/MF A01. File Number DE85000072.

From Automotive technology development contractor coordination meeting; Dearborn, MI, USA (13 Nov 1983).

A progress report on a development program aimed at the enhancement of elevated temperature mechanical properties of ceramic matrixes strengthened by the transformation toughening (TT) technique is presented. Both alumina and mullite have been formulated containing a solid solution of ZrO_2 and HfO_2 ($Zr_{0\ 5}\ Hf_{0\ 5}\ O_2$). The addition of the HfO_2 is designed to preserve the TT effect at temperatures up to 2500F. Processes for formulating such materials have been identified, and measurements of K/sub IC/, modulus of rupture and compression strength are being conducted. The study is anticipated to lead to scale-up and design and fabrication of an appropriate diesel engine ceramic component for engine test.

31393 (CONF-831142—, pp 333-336) **Industry Perspectives Session.** Mar 1984. NTIS, PC A18/MF A01. File Number DE85000072.

From Automotive technology development contractor coordination meeting; Dearborn, MI, USA (13 Nov 1983).

A special session was convened to obtain constructive feedback from the conference attendees aimed at improving program content and gauging industry and program content and gauging industry and program participant opinion on a selection of relevant policy issues. The Industry Perspectives Session focused on specific issues dealing with current program content and future program direction, industry coordination, and technology transfer. To facilitate obtaining quantitative feedback from the audience, Dr. David E. Cole, Professor of Mechanical Engineering, University of Michigan, framed a series of questions on each of the issues for which he also provided the necessary background information. One hundred and seventy-six (176) conference attendees participated in this session.

31394 (CONF-831142—, pp 405) **Results of the Coordinating Research Council methanol-gasoline blends program.** Gallopoulos, N.E. (General Motors Research Labs., Warren, MI). Mar 1984. NTIS, PC A18/MF A01. File Number DE85000072.

From Automotive technology development contractor coordination meeting; Dearborn, MI, USA (13 Nov 1983).

The Coordinating Research Council, Inc. (CRC) conducted a test program designed to define the emissions, fuel economy, driveability, and vapor lock characteristics of volatility-adjusted methanol-gasoline blends versus gasoline. The fuels were tested in 1980 model year cars representing various emission control technologies using test procedures accepted by the Federal Government and industry. Six unleaded fuels were used for this phase of the program: a reference gasoline and five methanol blends. The methanol-gasoline blends had oxygen contents ranging between 1 and 8%, and included fuels with and without isobutanol co-solvent. Ten 1980 model cars were used. The study showed that methanol in gasoline affected most vehicle performance parameters. Organic and carbon monoxide tailpipe emissions were reduced, but effects on other emissions, driveability, and fuel economy were generally adverse with methanol at the higher concentrations. Another experimental program is needed to define the response of vehicle performance factors to fuel characteristics such as oxygen content and volatility, which this program strongly suggests are the two most influential on vehicle performance.

31395 (CONF-831142—, pp 369-376) **Investigation of the potential for improving efficiency of a spark ignition engine operating on natural gas - Phase I status report.** O'Neal, G.B. (Southwest Research Institute, San Antonio, TX). Mar 1984. NTIS, PC A18/MF A01. File Number DE85000072.

From Automotive technology development contractor coordination meeting; Dearborn, MI, USA (13 Nov 1983).

The ebbing tide of cheap fossil-based liquid hydrocarbon fuels has stimulated interest in alternate fuels for spark-ignition engines. Since natural gas (methane) is readily available and enjoys a favorable cost advantage through lower taxes and price regulation, the popularity of engine conversion to natural gas has increased significantly in recent years. However, fuel cost rather than energy efficiency has been the primary motivation behind these engine conversions, and little emphasis has been placed on the antiknock, wide flammability, and emissions characteristics of methane. The most efficient utilization of methane as a motor fuel can be achieved only in an engine optimized for this fuel. Since there are so many different types and applications of spark-ignition engines, this project was aimed at a specific engine application - the light duty vehicle used in fleet operation. The objective of this project was then to evaluate in the laboratory performance, economy, and emissions improvements obtainable from a spark-ignition engine representative of those used in fleet operation of light duty vehicles.

31396 (CONF-831142—, pp 377-382) **Advanced on-board storage concepts for compressed natural gas fueled automotive vehicles.** Remick, R.J.; Camara, E.H. (Institute of Gas Technology, Chicago, IL). Mar 1984. NTIS, PC A18/MF A01. File Number DE85000072.

From Automotive technology development contractor coordination meeting; Dearborn, MI, USA (13 Nov 1983).

A parametric study of methane adsorption on high surface area carbons and high pore volume zeolites was undertaken to identify those properties which exercise the greatest influence on the storage capacity of an adsorption system. Results indicate that adsorbent systems utilizing activated carbon are better than systems utilizing zeolites both on a gas delivered per unit volume and a gas delivered per unit weight basis. The best results were obtained with high surface area carbons with high packing density. This work tentatively suggests that storage capacities equal to those obtained by compression systems operating at 137 atm (13.9 MPa) can be achieved by adsorption systems operating at pressures below 35 atm (3.6 MPa). The best results observed to date have achieved 70% of this goal.

31397 (CONF-831142—, pp 231-240) **Room and elevated temperature sliding contact-stress behavior of transformation-toughened zirconium oxide ceramics.** Lindberg, L.J. (Garrett Turbine Engine Co., Phoenix, AZ). Mar 1984. NTIS, PC A18/MF A01. File Number DE85000072.

From Automotive technology development contractor coordination meeting; Dearborn, MI, USA (13 Nov 1983).

Monolithic SiC and Si_3N_4 are susceptible to contact-stress damage at static and sliding interfaces. A program was initiated in 1983 to evaluate transformation-toughened zirconium oxide (TTZ) under similar contact conditions to determine if a higher material fracture toughness would reduce the susceptibility to contact-stress damage. Contact-stress tests have been conducted on Nilsen TS-grade magnesia stabilized and NGK Z-191 ytrria stabilized TTZ at normal loads ranging from 1 to 50 pounds at temperatures of room temperature, 1000, 1400, 1600, 1800, 2000 and 2200°F. Static and dynamic friction were measured as a function of temperature. Flexural strength measurements after these tests determined that the contact-stress exposure did not reduce the strength of the TTZ materials. Prior tests with the lower toughness SiC and Si_3N_4 materials resulted in substantial strength reduction at loads of only 10 to 25 pounds. An increase in material toughness appears to improve ceramic material resistance to contact-stress damage. Additional tests are in progress to evaluate the stress-rupture capability of the TTZ materials. Initial stepped-stress rupture tests have determined that the TTZ materials are susceptible to deformation due to creep and that the onset of creep occurs at different temperatures and stresses for the various TTZ materials.

31398 (CONF-831142—, pp 241-252) **Solid lubrication design methodology.** Aggarwal, B.B. (SKF Industries, Inc., King of Prussia, PA). Mar 1984. NTIS, PC A18/MF A01. File Number DE85000072.

From Automotive technology development contractor coordination meeting; Dearborn, MI, USA (13 Nov 1983).

A single element traction rig is used to measure the traction forces at the contact of a ball against a flat disc at room temperature under combined rolling and sliding speeds. The contact is lubricated by burnishing the lubricant on the disc surface before it enters the contact. Preliminary results using 440C balls and M50 discs show that the traction force is more sensitive to load than to rolling velocity. Traction force vs. time curves have accentuated the importance of adequate lubricant replenishment for maintaining a stable traction force and preventing surface damage.

31399 (CONF-831142—, pp 339-348) **Effects of fuel molecular structure on diesel exhaust particulates.** Ng, H.K.; Borman, G.L. (Univ. of Wisconsin, Madison). Mar 1984. NTIS, PC A18/MF A01. File Number DE85000072.

From Automotive technology development contractor coordination meeting; Dearborn, MI, USA (13 Nov 1983).

Six different fuels were tested using a modified TACOM-LABECO single cylinder diesel with a four hole nozzle and 24:1 compression. The engine condition was fixed at 22° btdc injection timing, 0.5 equivalence ratio, 1000 rpm, naturally aspirated and medium swirl. Data taken included exhaust particulate mass and cylinder pressure-time. The six fuels tested were commercial diesel fuel No. 1 and 2 blended to give a cetane number 43.3, JP-7 fuel with a cetane of 57.2 and only 2% aromatic content, two blends of one-ring aromatic solvent and JP-7 giving cetanes of 31.3 and 41.7 and two blends of two-ring aromatic solvent and JP-7 giving cetane numbers of 30.3 and 41.2 respectively. The two-ring aromatic blends gave 25-30% more particulates than the corresponding cetane one-ring blends. Both the one and two-ring blends showed that as aromatic content is increased beyond a certain point the resulting decrease in cetane number can cause a decrease in particulates despite the increase in aromatic content.

31400 (CONF-831142—, pp 349-360) **Flame propagation in heterogeneous mixtures of fuel drops and air.** Myers, G.D.; Lefebvre, A.H. (Garrett Turbine Engine Co., Phoenix, AZ). Mar 1984. NTIS, PC A18/MF A01. File Number DE85000072.

From Automotive technology development contractor coordination meeting; Dearborn, MI, USA (13 Nov 1983).

Photographic methods are used to measure flame speeds in flowing mixtures of fuel drops and air at atmospheric pressure. The fuels employed include a conventional fuel oil plus various blends of JP 7 with stocks containing single-ring and two-ring aromatics.The results for stoichiometric mixtures show that flame propagation cannot occur in mixtures containing mean drop sizes larger than 300 to 400 microns, depending on the fuel type. For smaller drop sizes, down to around 60 microns, flame speed is inversely proportional to drop size, indicating that evaporation rates are limiting to flame speed. Below around 60 microns, the curves of flame speed versus mean drop size, flatten out, thereby demonstrating that for finely atomized sprays flame speeds are much less dependent on evaporation rates, and are governed primarily by mixing and/or chemical reaction rates. The fuels exhibiting the highest flame speeds are those containing two-ring aromatics. This is attributed to the higher radiative heat flux emanating from their soot-bearing flames which enhances the rate of evaporation of the fuel drops approaching the flame front.

31401 (CONF-831142—, pp 361-368) **Utilization of shale and coal derived fuels in diesel engines.** Trevitz, S.S.; Lestz, S.S. (Pennsylvania State Univ., University Park). Mar 1984. NTIS, PC A18/MF A01. File Number DE85000072.

From Automotive technology development contractor coordination meeting; Dearborn, MI, USA (13 Nov 1983).

Four alternative fuels synthesized from shale and coal were tested for use in diesel engines. A single-cylinder DI diesel engine was used to compare these fuels with respect to a certified baseline DF-2 on the basis of combustion characteristics, performance, gaseous emissions, and particulate emissions. In addition, the biological activity of the particulate emission soluble organic fraction was assessed using TA-98$^-$ in the Ames Salmonella typhimurium test. The shale fuels studied included a Paraho marine diesel fuel and a light shale oil condensate from the Logan Wash in situ retorting operation. The coal liquids, Solvent Refined Coal-II and Exxon Donor Solvent, could not be run neat; therefore, they were blended 20% and 40% by volume with the baseline DF-2. The blended coal liquids and the light shale oil induced long ignition delays whereas the Paraho marine diesel fuel exhibited good finished fuel characteristics.

31402 (CONF-831142—, pp 383-388) **Future diesel fuel quality and its effects on existing engine performance; alternatives to diesel - the Canadian situation.** James, B.A. (Energy, Mines and Resources, Ottawa, Ontario). Mar 1984. NTIS, PC A18/MF A01. File Number DE85000072.

From Automotive technology development contractor coordination meeting; Dearborn, MI, USA (13 Nov 1983).

The quality of crude oil feedstocks available in Canada is expected to change considerably in the next decade. Feedstock will include more synthetic tar derived crudes, which are higher crudes. A reference diesel fuel for the 1990s has been developed and used in several medium and high speed engines. No major operational difficulties were experienced. In addition to crude supply and quality problems the gasoline to distillate ratio in refineries is being reduced due to conversion, substitution and dieselization of small trucks and cars. Development of alternatives to diesel are being developed. Canada's programs for using propane, natural gas, methanol, ethanol and canola oil are discussed.

31403 (CONF-831142—, pp 391-398) **Neat methanol as a fuel for compression ignition engines in transit bus operation.** Bennethum, J.E. (Detroit Diesel Allison, MI). Mar 1984. NTIS, PC A18/MF A01. File Number DE85000072.

From Automotive technology development contractor coordination meeting; Dearborn, MI, USA (13 Nov 1983).

Methanol has emerged as the most likely alternate to petroleum fuels. The primary reasons are abundant feedstocks, simple production technology, and potential cost competitiveness. Detroit Diesel has demonstrated that the two-stroke compression ignition engine is capable of auto-igniting pure methanol when the engine is at normal operating temperatures. This methanol engine has performance and brake thermal efficiency levels similar to a comparable diesel. Emissions of NOx and particulates, however, are substantially lower. Using methanol in transit buses presents the opportunity to reduce the significant bus contribution to the total suspended particulates in the major urban areas of the US. Although numerous questions remain to be answered before a US methanol economy becomes a reality, Detroit Diesel is doing the research and development required now to insure that methanol engines are available when needed.

31404 (CONF-831142—, pp 255-262) **Ceramic Applications in Turbine Engines (CATE) program summary.** Thrasher, S.R. (General Motors Corp., Indianapolis, IN). Mar 1984. NTIS, PC A18/MF A01. File Number DE85000072.

From Automotive technology development contractor coordination meeting; Dearborn, MI, USA (13 Nov 1983).

The objective of the Ceramic Applications in Turbine Engines (CATE) program was to utilize ceramic components in a highway vehicle gas turbine engine, thereby reducing fuel consumption by improving engine cycle efficiency due to operation at higher temperatures. The Allison CATE 404-4 was the test engine for this program. An evolutionary approach was employed, beginning with the introduction of ceramic components at 1900°F turbine inlet temperature. As test results from the 1900°F-configuration ceramic components became available, the 2070°-configuration components were designed. Both the 1900°F and 2070°F ceramic components were rig and engine demonstrated to maximum operating conditions. The CATE program has provided a sound technology base for ceramic components in gas turbine engines. This technology is being used in several areas at Allison, including development programs for the AGT 100, the low heat rejection diesel, the industrial Model 501-K engine, and the Teledyne Excentrix cruise missile engine.

31405 (CONF-831142—, pp 263-272) **AGT 100 Advanced Gas Turbine Technology Project.** Groseclose, L.E.; Helms, H.E.; Johnson, R.A. (General Motors Corp., Indianapolis, IN). Mar 1984. NTIS, PC A18/MF A01. File Number DE85000072.

From Automotive technology development contractor coordination meeting; Dearborn, MI, USA (13 Nov 1983).

The AGT 100 Advanced Gas Turbine Technology Project continued its proof-of-principle examination of an alternative engine for passenger car propulsion. Evaluation of small, high-efficiency components included combustor and regenerator rig testing, and a new thermal shock rig is being brought aboard for testing static ceramic turbine components. Ceramic component development has focused on injection-molded turbine rotors and slip-cast turbine scroll assemblies. Also emphasized was the development of methods for detecting flaws in ceramic components. Several acoustic techniques are being pursued. Two experimental engines have been fabricated and tested for a total of 41 hours, evenly divided between the two. The second engine achieved its 20 hours on one build of the turbomachinery. Several ceramic components have been engine tested at typical heat-up rates. All engine testing has been accomplished using ceramic combustor, regenerator disk and bulkheat, and various insulators and spacers.

31406 (CONF-831142—, pp 273-286) **AGT101 advanced gas turbine development program.** Kreiner, D.M.; Kidwell, J.R. (Garrett Turbine Engine Co., Phoenix, AZ). Mar 1984. NTIS, PC A18/MF A01. File Number DE85000072.

From Automotive technology development contractor coordination meeting; Dearborn, MI, USA (13 Nov 1983).

The Garrett/Ford Advanced Gas Turbine (AGT) Technology Project, authorized under NASA Contract DEN3-167, is sponsored by and is part of the US Department of Energy Gas Turbine Highway Vehicle System Program. Program effort is oriented at providing the US automotive industry the high-risk long-range technology necessary to produce gas turbine powertrains for automobiles that will have reduced fuel consumption and reduced environmental impact. The AGT101 powersection is a 100 hp, regenerated single-shaft gas turbine engine operating at a maximum turbine inlet temperature of 2500°F. Maximum rotor speed is 100,000 rpm. All high temperature components, including the turbine rotor, are ceramic. Development has progressed through aerothermodynamic testing of all components with compressor and turbine performance goals achieved. Some 170 hours of AGT101 (1600°F) testing has been accumulated on three metal engines. Individual and collective ceramic component screening tests to 2100°F have been successfully accomplished. In addition, ceramic turbine rotors have been successfully cold spun to the required 115,000 rpm proof speed (15% overspeed) and subjected to dynamic thermal shock tests simulating engine conditions. Assembly of the engine with ceramic structures is underway. Engine testing of the ceramic structures and the ceramic turbine rotor is planned in the near future.

31407 (CONF-831142—, pp 291-296) **Fabrication of silicon nitride turbine engine components.** Carruthers, D.W.; Liu, F.S.; Solidum, E.I. (Garrett Turbine Engine Co., Phoenix, AZ). Mar 1984. NTIS, PC A18/MF A01. File Number DE85000072.

From Automotive technology development contractor coordination meeting; Dearborn, MI, USA (13 Nov 1983).

The AiResearch Casting Company (ACC) is fabricating silicon nitride components for use in the Garrett/Ford AGT101 engine development program. Fabrication approaches were selected based on their suitability in an iterative development approach, on component size and on material property requirements. Reaction bonded Si_3N_4 static components are being fabricated to near net shape by slip casting or injection molding methods. Fabrication parameters for components of varying cross section, complexity, and size have been developed. Sets of static hardware including stators, turbine shrouds and inner and outer diffusers have been successfully screened individually and as an assembly in cyclic simulated engine conditions to 2100°F. Sintered Si_3N_4 radial rotors are being developed using a slip casting approach. Fabrication of this thick-hub/thin-blade art has required careful mold preparation and drying cycle development. Sintered development is being performed at both Ford and ACC. Rotors have been successfully tested in room temperature spin testing to 115,000 rpm and by cyclic thermal transient simulation.

31408 (CONF-831142—, pp 297-306) **Development of alpha silicon carbide components for gas turbine applications.** Tompkins, F.C. Jr. (Carborundum Co., Niagara Falls, NY). Mar 1984. NTIS, PC A18/MF A01. File Number DE85000072.

From Automotive technology development contractor coordination meeting; Dearborn, MI, USA (13 Nov 1983).

The progress and current status of the development of α silicon carbide components for both the AGT 100 and AGT 101 Advanced Gas Turbine Programs are described. The general approach taken to the successful fabrication of ceramic parts is presented. For each component, the following considerations are given: fabrication approach; problems encountered; solutions implemented to resolve problem areas; and progress demonstrated.

31409 (CONF-831142—, pp 307-314) **Characterization of sintered reaction bonded silicon nitride.** Mangels, J.A.; Baer, J.R.; Govila, R.K. (Ford Motor Co., Dearborn, MI). Mar 1984. NTIS, PC A18/MF A01. File Number DE85000072.

From Automotive technology development contractor coordination meeting; Dearborn, MI, USA (13 Nov 1983).

The properties of a series of slip cast sintered reaction bonded silicon nitrides are reviewed including the current grade, RM-3. This material has a room temperature strength of 100 Ksi and a Weibull modulus of 19 and exhibits good stress rupture behavior at moderate stress levels. It can survive testing at stress levels up to 40 Ksi and temperatures between 800 and 1000°C for times up to 500 hours without failure. The material characterization techniques used to evaluate these materials are also reviewed and discussed. The interaction between material development and material evaluation is stressed as is the need to continually develop testing procedures which can properly evaluate these materials.

31410 (CONF-831142—, pp 315-322) **Injection molded silicon nitride for engine applications: fabrication and properties.** Bandyopadhyay, G.; French, K.W.; Quackenbush, C.L. (GTE Laboratories Inc., Waltham, MA). Mar 1984. NTIS, PC A18/MF A01. File Number DE85000072.

From Automotive technology development contractor coordination meeting; Dearborn, MI, USA (13 Nov 1983).

Development of injection molded and sintered silicon nitride ceramics is continuing at GTE Laboratories for application in engine components. Both small (CATE axial turbine blades) and large (AGT 100 rotor) cross-section parts have been fabricated with good maintenance of geometry. CATE blades failed at an average of 136% of design speed in cold spin tests. They also exhibit good oxidation resistance. Fabrication of AGT rotors by sintering is currently limited by burnout cracking. Progress has been made in controlling these cracks. Preliminary experiments show that hot isostatic pressing can eliminate macroscopic internal flaws from AGT rotors.

31411 (CONF-831142—, pp 323-330) **Ceramic life prediction methodology.** Swank, L.R.; Baker, R.R.; Lenoe, E.M. (Ford Motor Co., Dearborn, MI). Mar 1984. NTIS, PC A18/MF A01. File Number DE85000072.

From Automotive technology development contractor coordination meeting; Dearborn, MI, USA (13 Nov 1983).

The objective of this program is to generate a time to failure data base on a gas turbine component and to compare the experimentally determined reliability versus time to calculated reliability versus time. To meet this objective a rotating disc was designed to fail due to time dependent mechanisms. Several discs were fabricated and an existing test rig was developed to test the discs at design conditions. Ten discs were tested at steady state under the design conditions of 2300°F rim temperature and 50,000 rpm for periods of 0.20 hours to 25 hours. An experimental failure distribution was obtained for the ten discs and presented as reliability versus time. Three different data bases were used to calculate reliability versus time and the results were compared to the experimental results.

31412 **(DOE/AL/16338—T1) Modeling of engine sprays.** Bracco, F.V. (Princeton Univ., NJ (USA). Dept. of Mechanical and Aerospace Engineering). 1985. Contract AC04-81AL16338. 24p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85010020.

Atomization and full-cone sprays from single cylindrical orifices are considered. The following subjects are reviewed: the structure of the breakup region; the structure of the far field; modern models that, given the outcome of the breakup process, compute the steady and transient of sprays; some comparisons with detailed measurements; and some practical applications. The following conclusions are reached: the spray breakup and the development regions are the most relevant in engine applications; the inner structure of the breakup region is still largely unknown; two- and three-dimensional spray models are available but remain mostly untested, particularly in their vaporization and combustion components, in part because of a lack of accurate measurements in controlled engine-type environments; engine applications of such models are, nonetheless, recommended for very valuable learning, interpretative, and exploratory studies, but not for predictions.

3302 External Combustion Engines

REFER ALSO TO CITATION(S) 31379, 31393

31413 (CONF-831142—, pp 1-14) **Automotive Stirling Engine Development Program: overview and status report.** Nightingale, N.P. (Mechanical Technology Inc., Latham, NY). Mar 1984. NTIS, PC A18/MF A01. File Number DE85000072.

From Automotive technology development contractor coordination meeting; Dearborn, MI, USA (13 Nov 1983).

The Automotive Stirling Engine (ASE) Development Program has been funded by DOE/NASA-Lewis Research Center since March 1978. To date, four first-generation automotive Stirling engines (called Mod I) have accumulated more than 3667 test hours. Two additional engines will be assembled and delivered to General Motors and John Deere for test and evaluation in 1984. The Reference Engine System Design (RESD), the engine design that most closely meets the overall program objectives, was modified in 1983 to reduce manufacturing cost while maintaining engine/vehicle performance. The revised RESD is projected to achieve an increase in specific power and a reduction in specific volume and manufacturing cost. Predictions indicate that fuel economy 48.5% above that of a comparable internal-combustion engine/vehicle installation has been attained. Two Mod I engines have been retrofitted with upgraded hardware to demonstrate design concepts embodied in the RESD. These upgraded engines have accumulated more than 325 test hours.

31414 (CONF-831142—, pp 15-26) **Automotive Stirling engine component development advances.** Ernst, W.D. (Mechanical Technology Inc., Latham, NY). Mar 1984. NTIS, PC A18/MF A01. File Number DE85000072.

From Automotive technology development contractor coordination meeting; Dearborn, MI, USA (13 Nov 1983).

Component development is a vital aspect of the Automotive Stirling Engine (ASE) Development Program. The objective of this activity is to advance Stirling engine technology with an emphasis on cost, performance, and design simplicity. Significant achievements have been made in each engine system area. These include, but are not limited to, elimination of strategic materials in the heater head; reduction of drive friction and elimination of low rpm power limit through use of rolling element drive; and a 75% reduction in combustion air system parts. Such advances have led to both performance improvements and simplification of the various engine systems; these advances allow the program effort to enter a new development phase. The challenge now lies in integrating the various system components into a complete engine and then proving this design by extensive test cell and transient testing.

31415 (CONF-831142—, pp 27-40) **Mod I Stirling engine performance data and analysis.** Richey, A.E. (Mechanical Technology Inc., Latham, NY). Mar 1984. NTIS, PC A18/MF A01. File Number DE85000072.

From Automotive technology development contractor coordination meeting; Dearborn, MI, USA (13 Nov 1983).

Engine testing conducted under the ASE program in the past year included further Mod I development and initial tests on the Upgraded Mod I engine. Data are also now available on the first Mod I engine built in the US, the Mod I engine No. 10. Transient test bed (TTB) testing of engine No. 1 produced additional development information, and a 1000-hour simulated, constant volume sampling (CVS) endurance test was conducted on engine No. 3. The first Upgraded Mod I engines have been development tested. Performance levels of the initial Upgraded Mod I were disappointing; however, an intensive test program identified the major problem areas, and corrective action has been taken to improve performance levels. An update of engine experience in the Mod I arena and the results of the Upgraded Mod I test program that commenced on schedule in April 1983 are presented. Early steady-state and transient testing of the Mod I engine were reported in previous Automotive Technology Development Contractors' Coordination Meetings.

31416 (CONF-831142—, pp 41-46) **Statistical life-testing of Stirling engine main seals (84ASE359TR29).** Lundholm, G. (United Stirling AB, Malmoe, Sweden). Mar 1984. NTIS, PC A18/MF A01. File Number DE85000072.

From Automotive technology development contractor coordination meeting; Dearborn, MI, USA (13 Nov 1983).

A series of endurance tests with two P40 Stirling engines is described. The tests were run according to specified duty cycles. The purpose was to gain an improved understanding on the variation in main seal oil leakage between different seal individuals manufactured to the same drawing and run to the same duty cycle, and also to investigate how different parameters influence main seal oil leakage rate. Running time was in most cases 500 hours. Graphs are presented, which show extent of oil leakage at end of each run. It is found that the crosshead diametral clearance is of importance for the following crosshead clearances of cylinder No. 1-4: Normal, 64% over max, 104% over max, and 140% over max. This test showed clearly that the oil leakage rate increased with increasing crosshead clearance.

31417 (CONF-831142—, pp 47-53) **Experimental evaluation of working gas containment in the automotive Stirling engine.** Cairelli, J.E.; Skog, E. (National Aeronautics and Space Administration, Cleveland, OH). Mar 1984. NTIS, PC A18/MF A01. File Number DE85000072.

From Automotive technology development contractor coordination meeting; Dearborn, MI, USA (13 Nov 1983).

Two United Stirling 4-95 engines were tested to evaluate the status of Automotive Stirling Engine (ASE) hydrogen working gas containment and to evaluate the use of CO_2 dopant gas to reduce heater tube permeation. The goal of the ASE is to operate for 6 months without H_2 recharge. The test results indicate the best recharge time achieved with a 4-95 engine, having minimum hydrogen piping and operating with pure H_2 at 720°C (the normal operating temperature), was 3.1 months and at 820°C (the proposed operating temperature for the ASE) was 2.1 months. By using 1% CO_2 doped H_2 the times were increased to 3.8 months and 2.7 months, respectively. Use of CO_2 dopant reduced H_2 permeation through N155 heater tubes up to 50% at 820°C with little change in maximum power and efficiency. However permeation at 820°C with N155 tubes, even with CO_2 doped H_2, is too high to achieve 6 months between recharges. Both static and dynamic piston rod seal leakage appear to be small. Leakage from static seals like O-rings are the major factor in meeting the recharge goal.

31418 (CONF-831142—, pp 55-62) **Initial testing of a variable-stroke Stirling engine.** Thieme, L.G. (National Aeronautics and Space Administration, Cleveland, OH). Mar 1984. NTIS, PC A18/MF A01. File Number DE85000072. Contract AI01-77CS51040.

From Automotive technology development contractor coordination meeting; Dearborn, MI, USA (13 Nov 1983).

In support of the US Department of Energy's Stirling Engine Highway Vehicle Systems Program, NASA Lewis Research Center is evaluating variable-stroke control for Stirling engines. The engine being tested is the Advenco Stirling engine; this engine was manufactured by Philips Research Labs of the Netherlands and uses a variable-angle swashplate drive to achieve variable-stroke operation. The engine, initial steady-state test data taken at Lewis, and a major drive system failure and subsequent modifications are described. Finally, computer simulation results are presented to show potential part-load efficiency gains with variable-stroke control.

31419 (CONF-831142—, pp 63-72) **Stirling engine heater head stress analysis (84ASE360TR30).** Groenwall, J. (United Stirling AB, Malmoe, Sweden). Mar 1984. NTIS, PC A18/MF A01. File Number DE85000072.

From Automotive technology development contractor coordination meeting; Dearborn, MI, USA (13 Nov 1983).

An overview of the stress analysis work done on different heater head designs during the Automotive Stirling Engine program is presented. A close interaction between design and analysis has resulted in successive design improvements, which are discussed here. The input requirements for stress analysis of a heater head include design, loading conditions, material data, analysis method and stress criteria. The paper describes how each one of these areas has been developed during the program. Experienced structural integrity problems on the heater head components are discussed and solutions for these problems are suggested. The paper completes by looking at future plans concerning the stress analysis of heater heads.

31420 (CONF-831142—, pp 73-82) **Ceramic automotive Stirling engine conceptual design.** Chiu, W.; Darooka, D.K.; Musikant, S. (General Electric Co., Cincinnati, OH). Mar 1984. NTIS, PC A18/MF A01. File Number DE85000072.

From Automotive technology development contractor coordination meeting; Dearborn, MI, USA (13 Nov 1983).

General Electric Company is conducting a conceptual design study under the sponsorship of NASA-LeRC/DOE (Contract DEN 3-312) to evaluate the feasibility of a ceramic automotive Stirling engine. Using the Automotive Stirling Reference Engine design as a reference, a preliminary determination of the feasibility of using ceramic materials on the hot side of the engine is being conducted. The performance and benefits which may be derived from the use of ceramics have been estimated. Estimates of manufacturing and operating costs are being made. So far the investigation is quite favorable for the feasibility of a Ceramic Automotive Stirling Engine. The program is presently continuing with the evaluation of material processes, fabrication techniques and manufacturing cost estimation.

31421 (CONF-831142—, pp 83-92) **Free-piston Stirling engine endurance test program.** Dochat, G.; Rauch, J.; Antonelli, G. (Mechanical Technology Inc., Latham, NY). Mar 1984. NTIS, PC A18/MF A01. File Number DE85000072.

From Automotive technology development contractor coordination meeting; Dearborn, MI, USA (13 Nov 1983).

The Free-Piston Stirling Engine (FPSE) has the potential to be a long-lived, highly reliable, power conversion device attractive for many product applications such as space, residential, or remote-site power. The purpose of endurance testing the FPSE is to demonstrate its potential for long life. The endurance program was directed at obtaining 1000 operational hours under various test conditions: low power, full stroke, duty cycle, and stop/start. Critical performance parameters were measured to note any change and/or trend. Inspections were conducted to measure and compare critical seal-bearing clearances. The engine performed well throughout the program, completing the 1000 hours. Hardware inspection, including the critical clearances, showed no significant change in hardware or clearance dimensions. The performance parameters did not exhibit any increasing or decreasing trends. The test program confirms the potential for long-life FPSE applications. Additional testing is planned to increase the test hours to 10,000.

31422 (CONF-831142—, pp 93-96) **Low cost Stirling engines.** Beale, W. (Sunpower, Inc., Athens, OH). Mar 1984. NTIS, PC A18/MF A01. File Number DE85000072.

From Automotive technology development contractor coordination meeting; Dearborn, MI, USA (13 Nov 1983).

Simple low cost and commercially attractive Stirlings have recently evolved to the point where they deserve industry attention. By their design and intended use they avoid the exceptionally challenging difficulties of automotive and other demanding Stirling applications. The design procedures needed have quite recently become generally available, and several technically successful configurations intended for roles unaccessable to IC engines have been built and demonstrated. The time has come for the attentions of the US industry to be directed toward the promise of Stirling engines in a wide variety of simple and readily accessable nonautomotive applications.

3303 Electric-powered Systems

REFER ALSO TO CITATION(S) 31060, 31065

31423 **(DOE/CS/54209—22) Advanced vehicle systems assessment. Volume 1. Executive summary.** Hardy, K.S. (Jet Propulsion Lab., Pasadena, CA (USA)). Jan 1985. Contract AI01-78CS54209. 29p. (JPL-PUB—84-79). NTIS, PC A03/MF A01; GPO Dep. File Number DE85008643.

This report, which is divided into five volumes, documents the evaluation of advanced electric and hybrid vehicles for potential development by the early 1990's. The primary objective of the assessment is to recommend subsystem research priorities based on a comparison of alternatives as part of complete vehicle systems with equivalent performance. The assessment includes evaluations of candidate technologies as well as technical and economic comparisons of vehicle systems for specified missions. The availability of nonpetroleum fuel is also addressed, and preference analyses are used to assist in the evaluation of the relative merits of competing systems.

31424 **(DOE/NV/10103—1) City of Tucson, Arizona, electric vehicle report, April 1, 1981-May 31, 1985. Final report.** (Tucson, City of, AZ (USA)). 1985. Contract FC08-80NV10103. 22p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85012774.

Results of a four-year demonstration project for electric vehicles are reported. Ten electric vehicles were used. Difficulties occurred: limited range (35 to 40 miles before recharge), and reversal of the oil crisis. The vehicles could not be used after dark, and the air conditioner could be used only sparingly. (DLC)

31425 **(EGG-SE—6764) Test plan for performance testing of the Eaton AC-3 electric vehicle.** Crumley, R.L.; Heiselmann, H.W. (EG and G Idaho, Inc., Idaho Falls (USA)). Apr 1985. Contract AC07-76ID01570. 34p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85011954.

An alternating current (ac) propulsion system for an electric vehicle has been developed and tested by the Eaton Corporation. The test bed vehicle is a modified 1981 Mercury Lynx. The test plan has been prepared specifically for the third modification to this test bed and identified as the Eaton AC-3. The scope of the EG and G testing at INEL to be done on the Eaton AC-3 will include coastdown and dynamometer tests but will not include environmental, on-road, or track testing. Coastdown testing will be performed in accordance with SAE J-1263 (SAE Recommended Practice for Road Load Measurement and Dynamometer Simulation Using Coastdown Techniques).

3304 Hybrid Systems

REFER ALSO TO CITATION(S) 31423

3306 Vehicle Design Factors

31426 **(EGG-ED—6725-Rev.1) Techniques to analyze vehicle coastdown data. Revision 1.** Venhuizen, J.R. (EG and G Idaho, Inc., Idaho Falls (USA)). Apr 1985. Contract AC07-76ID01570. 42p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85011953.

A method is presented in this report which uses least squares parameter estimation techniques to estimate the aerodynamic drag and rolling resistance coefficients from velocity versus time data taken during the coastdown. Central to any parameter estimation problem is a model of the process that contains the parameters of interest. A model is developed to describe the coastdown process, and an example problem is presented to show the computational methods developed for the data reduction process.

3307 Emission Control

REFER ALSO TO CITATION(S) 31399

3308 Alternative Fuels

REFER ALSO TO CITATION(S) 31394, 31395, 31401, 31402, 31403

36 MATERIALS

REFER ALSO TO CITATION(S) 29616

31427 **(CONF-8504116—2) Calculation of mixed depth for some metal-Si systems.** Poker, D.B. (Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85011907.

From Workshop on ion mixing and surface alloying II; Pasadena, CA, USA (19 Apr 1985).

Results for several metals in Si indicate that the moment method is usually the preferred method for determining mixed depth, due to its insensitivity to detector resolution and lack of an initial offset. (DLC)

31428 **(DOE/ER/10556—95) Fully plastic crack problems: solutions by a penalty method that pass the consistency check. Part I.** Shih, C.F.; Needleman, A. (Brown Univ., Providence, RI (USA). Div. of Engineering). Mar 1983. Contract AC02-80ER10556. 78p. NTIS, PC A05/MF A01; GPO Dep. File Number DE85011564.

We formulate a finite-element reduced integration penalty method applicable to plane strain problems with incompressible material behavior. This numerical method is employed to generate crack solutions for pure power hardening solids. For two configurations of interest in applications, an edge cracked panel subject to remote tension and an edge cracked panel subject to remote bending, we obtain solutions for a wide range of crack lengths and strain hardening behaviours.

31429 **(N—85-17928) Research and technology highlights of the Lewis Research Center.** (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1984. 52p. (NASA-TM—86899). NTIS, PC A04/MF A01.

Highlights of research accomplishments of the Lewis Research Center for fiscal year 1984 are presented. The report is divided into four major sections covering aeronautics, space communications, space technology, and materials and structures. Six articles on energy are included in the space technology section.

31430 **(PB—85-178051/XAB) Computerizing materials data - a workshop for the nuclear power industry. The report of a workshop held at Knoxville, Tennessee on May 2-3, 1984. Final report.** Rumble, J.; Westbrook, J.H. (National Bureau of Standards, Washington, DC (USA). Office of Standard Reference Data). Jan 1985. 48p. (NBS/SP—689). NTIS, PC A03/MF A01.

Also available from Supt. of Docs as SN003-003-02636-1. Sponsored by Metal Properties Council, Inc., New York, American Society for Metals, Metals Park, OH, American Society for Testing and Materials, Philadelphia, PA, and American Society of Mechanical Engineers, New York. Library of Congress catalog card No. 84-601161.

This report summarizes the recommendations of a Workshop in Computerized Materials Data as related to engineers in the nuclear power Industry. Four areas of discussion are featured: the content of a proposed data system; its size and data sources; the user interfaces and system capabilities; and ways of making further progress. In addition, changes in the use of materials data in the Nuclear Power Industry and progress-to-date in computerizing these data are presented.

3601 Metals And Alloys

REFER ALSO TO CITATION(S) 29622, 29727, 29812, 29893, 30060, 30650, 30651, 30675, 30688, 30689, 30690, 30723, 30744, 30748, 30822, 30918, 30919, 31086, 31728, 32144, 32485, 32994, 33010

31431 **(AERE-R—11525) Role of void nucleation in the swelling resistance of ferritic steel.** Little, E.A. (UKAEA Atomic Energy Research Establishment, Harwell. Materials Development Div.). Oct 1984. 15p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85701457.

FV448 ferritic-martensitic stainless steel has been irradiated with 1 MeV electrons to damage levels up to 40 displacements per atom (dpa) at temperatures in the range 350 deg C to 500 deg C. The microstructures after irradiation have been evaluated and compared with those produced by fast reactor irradiations to similar dose levels. Electron irradiation induces spatially homogeneous dislocation substructures and a uniform high density of small slow-growing voids, giving low swelling rates at a peak swelling temperature of approx. 425 deg C to 450 deg C. The microstructural evolution is in marked contrast to the heterogeneous dislocation substructures and near swelling immunity observed after fast reactor irradiations. The results are discussed in terms of void nucleation events, simplified rate theory and a previously proposed model for swelling resistance of ferritic steels based on a duplex system of interstitial dislocation loop geometries. The implications of the observed microstructures on the maintenance of long-term swelling resistance of ferritic steels in both fast and fusion reactor environments are briefly considered.

31432 **(BMI—1984-053) Investigations on the behaviour of reactor pressure vessel material 20 MnMoNi 55 during heat and stress relieving treatments. Vol. 1 and 2.** Blind, D.; Schroeder-Obst, D.; Herz, K.; Maidorn, C. (Bundesministerium des Innern, Bonn (Germany, F.R.); Stuttgart Univ. (Germany, F.R.). Staatliche Materialpruefungsanstalt). Nov 1984. 268p. (In German). NTIS (US Sales Only), PC A12/MF A01. File Number DE85751129.

Variation of various heat treatment parameters with regard to forging, hardening, tempering and stress-relieving has been applied to several heats of pressure vessel steels with the aim of testing the possibility to obtain higher notch impact energy values. On one hand the variation of heat treatment parameters within the limits of the current VdTUeV material sheet 401/4 5.80 did not result in outstanding improvements of toughness. On the other hand, when employing procedures which did not correspond to the specifications, e.g. tempering up to 100 h, an evident decrease of the upper shelf and an increase of the transition temperature could be observed. Nevertheless, the specified values were generally reached. Essentially, the observations on the test materials confirm, apart from a few exceptions, the positive practical experience with the material 20 MnMoNi 5 5. Based on these relations between thoughness and forging as well as heat treatment the manufacturer obtained, in accordance with the current research program, an outstanding improvement of toughness by means of various optimization measures which had the effect of optimal, evidently increased upper shelfs and which excluded difficulties concerning acceptance criteria, e.g. too high notch impact energy transition temperatures.

31433 **(BMI—1984-054) Exemplary representation of structural constitutions of steels used for nuclear power plant components, with particular emphasis on welding and heat treatment (5. technical report. Pt. 1).** Schroeder-Obst, D.; Kuppler, D. (Bundesministerium des Innern, Bonn (Germany, F.R.); Stuttgart Univ. (Germany, F.R.). Staatliche Materialpruefungsanstalt). Nov 1984. 125p. (In German). NTIS (US Sales Only), PC A06/MF A01. File Number DE85751137.

This 5th part of the technical report characterizes the nuclear reactor structural steels 22 NiMoCr 3 7, 20 MnMoNi 5 5, and 17 MnMoV 6 4 and their melts and constitution under heat treatment within the margin of the approved VdTUeV specifications, as well as under extreme conditions (melt compositions exceeding the limiting value, heat treatments beyond official VdTUeV regulations), as well as specimens simulating the heat-affected zones of such steels. The information is presented by means of metallographic structural characteristics, by microstructural characteristics, and by the corresponding mechanical and technological characteristic values, and by showing the interdependencies between these features. Thus this report, when the data are complete, offers the possibility of fully assessing and classifying steels used for nuclear power plant components with regard to materials structure and their behaviour in welded zones.

31434 **(BNL—36414) Methane-bubble formation in hydrogen-charged Fe-30 ppM C.** Snead, C.L. Jr.; Lynn, K.G.; Suenaga, M. (Brookhaven National Lab., Upton, NY (USA)). 1985. Contract AC02-76CH00016. 4p. (CONF-850169—13). NTIS, PC A02/MF A01; GPO Dep. File Number DE85012526.

From 7. international conference on positron annihilation; New Delhi, India (6 Jan 1985).

We have used positrons as a probe of the early-stage growth of methane bubbles in hydrogen-charged polycrystalline Fe. Ferrovac E (30 ppM C) was charged at 900 psi of H_2 at 475°C for various times to generate the methane internally. It is known that this process generates methane bubbles. Our results show that, even at very early bubble-growth stages, dislocations are generated. A lifetime definitely associated with trapping at bubbles is not observed, due either to trapping by dislocations that are generated and which can "screen" the bubbles, or by passivation of the bubbles as positron traps by the presence of hydrogen or methane in them. 11 refs., 5 figs.

31435 **(BNL—36570) Noble metals as incipient transition metals.** Watson, R.E.; Bennett, L.H. (Brookhaven National Lab., Upton, NY (USA); National Bureau of Standards, Washington, DC (USA)). 1985. Contract AC02-76CH00016. 13p. (CONF-850211—9). NTIS, PC A02/MF A01; GPO Dep. File Number DE85013283.

From 114. AIME annual meeting (includes Society of Mining Engineers); New York, NY, USA (24 Feb 1985).

This review is concerned with similarities and differences between noble and transition metal alloying. Two classes of experiments are inspected: impurity Moessbauer isomer shifts and photoemission of core and valence electron levels. At first glance they would appear to be in conflict concerning the direction of any charge transfer. In noble metal alloys this is associated with changes in d-electron count which are compensated by the non-d electrons. The sign of the change in d occupation is readily understood in terms of d band hybridization. The normalized isomer shifts show that the balance of d and non-d transfer terms must vary across a transition metal row and that while the noble metals, when acting as impurities, act much like the transition elements immediately adjacent to them, the charge transfer, when the noble metals are hosts, is quite different. These observations, taken with recent band theory population analyses, indicate that three charge transfer terms, those associated with d, s and p-like charge, have visible effects on alloying properties. The review also considers the long standing discrepancy between the elemental fcc-bcc structural energy differences of Kaufman and Bernstein which are standardly employed in phase diagram constructs versus those appropriate to the Engel-Brewer model of transition and noble metals. Comparison with recent 5d metal estimates, based on electron band theory total energy calculations, show one region of agreement with the Engel-Brewer values and another of agreement with Kaufman and Bernstein.

31436 **(CBPF-NF—013/83) Critical point of the fully-anisotropic quenched bond-random Potts ferromagnet in triangular and honeycomb lattices.** Tsallis, C.; Santos, R.J.V. dos. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1983. 21p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85701418.

On conjectural grounds an equation that provides a very good approximation for the critical temperature of the fully-anisotropic homogeneous quenched bond-random q-state Potts ferromagnet in triangular and honeycomb lattices is presented. Almost all the exact particular results presently known for the square, triangular and honeycomb lattices are recovered; the numerical discrepancy is quite small for the few exceptions. Some predictions that we believe to be exact are made explicit as well.

31437 (CEA-CONF—7390) **Semimetallic behaviour of SmS at high pressure.** Konczykowski, M.; Lapierre, F.; Haen, P.; Morillo, J.; Senateur, J.P. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)). Aug 1984. 14p. (CONF-840876—5). NTIS (US Sales Only), PC A02/MF A01. File Number DE85751301.

From International conference on valence fluctuations; Koln, F.R. Germany (27 Aug 1984).

The transition from semiconducting to metallic intermediate-valence behaviour occuring at 20 kbar in SmS is studied by resistivity and Hall-coefficient measurements (1.2<=T<=300 K, 4<=P<=21 kbar). The data are analyzed in a two-band-conduction model. It is concluded that an indirect band gap closes at 20 kbar and that a direct one persists above this transition.

31438 (CONF-8504115—4) **Fermi surface study of CeSb in the ferromagnetic and antiferromagnetic phases** . Aoki, H.; Crabtree, G.W.; Joss, W.; Hulliger, F. (Argonne National Lab., IL (USA)). Feb 1985. Contract W-31-109-ENG-38. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85012122.

From 5. international conference on crystalline field effects in f-electron systems: ICCF5; Sendai, Japan (15 Apr 1985).

We report a de Haas-van Alphen effect study of CeSb in the intermediate field antiferromagnetic phase and in the high field ferromagnetic phase. The experimental results are discussed in the light of the p-f mixing model and a new weak coupling model based on a band structure calculation with localized f orbitals.

31439 (CONF-8504116—3) **Survey of mixing in metal/insulator systems.** Appleton, B.R. (Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 10p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85011938.

From Workshop on ion mixing and surface alloying II; Pasadena, CA, USA (19 Apr 1985).

The conclusions from this survey to date are: Ion beam mixing (and pulsed laser mixing*) are valuable methods to induce interface interactions at low temperatures. In many cases one can control and tailor stoichiometries of mixing. In some cases ion beam (and pulsed laser) mixing can "initiate" reactions not possible by thermal processing. Nevertheless, equilibrium thermodynamic or chemical considerations have a much greater influence in dictating materials interactions (phase formation) than any nonequilibrium aspects of ion bombardment.

31440 (CONF-8505138—1) **Flux-line lattice anisotropy in V_3Si: observation and interpretation.** Christen, D.K.; Kerchner, H.R.; Sekula, S.T.; Chang, Y.K. (Oak Ridge National Lab., TN (USA)). Apr 1985. Contract AC05-84OR21400. 16p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85011935.

From Materials and mechanisms of superconductivity conference; Ames, IA, USA (29 May 1985).

The high-T/sub c/ A15 compound V_3Si belongs to a small class of intrinsically high-κ, clean, type-II superconductors. For such a material in the low-field mixed state, the inter-flux-line forces are dominated by the microscopic field interaction. We have observed directly manifestations of anisotropic flux line (FL) interactions by means of small-angle neutron scattering (SANS) from the flux-line lattice (FLL) in a high quality single crystal of V_3Si. Pronounced correlations were found between the FLL morphology (orientation and symmetry) and the symmetry of the real crystal (CL) axis parallel to the applied field. Morover, for a fixed sample orientation in the field, we observe changes in the FLL symmetry with flux density B. We have interpreted the data in terms of weak nonlocality in the electrodynamic response, and anisotropy in the Fermi surface and electron-phonon interaction of the cubic material. A reciprocal space power series expansion for the mixed state free energy is obtained and fitted to the observed FLL morphology. The results are compared with those of previously measured H/sub c2/ and gap anisotropy.

31441 (DOE/AL/18071—T5) **[Beryllium production. Monthly technical progress report, 1 April-5 May 1985].** (Brush Wellman, Inc., Cleveland, OH (USA)). [1985]. Contract AC04-82AL18071. 9p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85013360.

This Monthly Technical Progress Report for the period 1 April 1985 through 5 May 1985, summarizes progress on Task IV of DOE Contract DE-AC04-82AL18071 for Research and Development Study for the optimization of beryllium production operations for government purposes. Task IV is operation of the subscale demonstration models of recommended alternative beryllium production processes.

31442 (DOE/ER/06039—T2) **Hydrogen embrittlement testing. [Final report].** (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA)). [1985]. Contract AS05-78ER06039. 3p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85007352.

Several important hydrogen induced effects were established. These effects included the observation of hydrogen-induced weakening of interfacial strength of boundaries such as twin boundaries, grain boundaries and slip bands. Impact and slow bend testing of hydrogen charged samples illustrated that this weakening is inherent with hydrogen absorption and that dislocation transport of hydrogen is not necessary for interfacial embrittlement to occur. These observations helped establish a phenomenological model for hydrogen embrittlement.

31443 (DOE/ER/45035—1) **Effect of microstructure on the fatigue behavior of Fe-C-X alloys. Final report, July 1, 1983-November 16, 1984.** Shiflet, G.J.; Jata, K.V.; Starke, E.A. Jr. (Virginia Univ., Charlottesville (USA). Dept. of Materials Science). Mar 1985. Contract AS05-83ER45035. 71p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85011749.

Purpose of the research is to establish the effect of microstructure on fatique behavior by controlling the relationship between ferrite, martensite, and carbides in ternary steels. Three alloys are being studied: Fe-0.2C-1Mn; Fe-0.2C-2Mo; Fe-0.2C-4Mo. The roles of austenite (martensite) and ferrite are being studied. 52 figs. (DLC)

31444 (DOE/ER/45096—1) **Stability of amorphous metal films on semiconductor substrates. Progress report, July-December 1984.** Wiley, J.D.; Perepezko, J.H. (Wisconsin Univ., Madison (USA)). Jan 1985. Contract FG02-84ER45096. 6p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85012401.

Goals were the examination of structural relaxation, measurement of diffusion in the amorphous films following relaxation to an isoconfigurational state, investigation of the stability of amorphous metals against electromigration, and assessment of crystallization and phase separations. Amorphous metals studied included Ni-Nb, W-Si, and Mo-Si. (DLC)

31445 (DOE/ER/45142—1) **Very low temperature studies of hyperfine effects in metals. [Progress report].** Weyhmann, W. (Minnesota Univ., Minneapolis (USA). School of Physics and Astronomy). 1985. Contract FG02-84ER45142. 10p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85013367.

We are using nuclei through the hyperfine coupling as a probe of magnetic interactions in metallic systems, emphasizing the role conduction electrons play. Three types of systems are of interest to us: nuclear singlet ground state intermetallic compounds, very dilute magnetic impurities in non-magnetic metals, and itinerant ferromagnets. The nuclear ordering in singlet ground state alloys of praseodymium appears to be analogous to electronic ordering in rare earth metals, with the RKKY interaction moderating the indirect exchange in both cases. We are measuring the static and dynamic properties of these materials both to study rare earth ordering, since only first order effects should play a role in the nuclear case, and to develop the sub-millikelvin refrigeration capabilities of these materials. Using this cooling power, we propose studying the local moment of Mn based Kondo systems at millikelvin and sub-millikelvin temperatures. Kondo systems with a Kondo temperature below 0.1 K have the advantage that magnetic saturation can be achieved with available magnets. We propose studying both the local magnetization as measured with nuclear orientation and the macroscopic magnetization measured with SQUID magnetometry. We also propose searching for electron polarization effects in itinerant ferromagnets using nuclear orientation. Induced hyperfine fields of less than 1 k0e can be detected at 1 mK.

31446 (DOE/ET/52023—34) **Simulating the CTR environment in the HVEM. Final report, September 1, 1975-August 31, 1984.** Jesser, W.A. (Virginia Univ., Charlottesville (USA). Dept. of Materials Science). 1984. Contract AS05-76ET52023. 18p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85011745.

The first high voltage electron microscope-ion accelerator facility in the world was established in 1976. Through use of this facility, helium embrittlement as revealed through intergranular fracture was shown to be independent of helium bubble content in the grain boundaries. This result is contrary to most current thinking and theories of helium embrittlement. The most likely mechanism of helium embrittlement is a plastic deformation assisted distribution of helium in finely dispersed helium-vacancy clusters. The key to overcoming helium embrittlement should lie in preventing the fine dispersion by providing benign sinks or treatments that agglomerate the helium.

31447 (GKSS—84/E/47) **Effect of damage rates and different kinds of irradiation on the ductility of amorphous $Fe_{40}Ni_{40}B_{20}$.** Gerling, R.; Schimansky, F.P.; Wille, P.; Wagner, R. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.)). 1984. 11p. (CONF-840902—19). NTIS (US Sales Only), PC A02/MF A01. File Number DE85751617.

From 5. ASTM-Euratom symposium on reactor dosimetry; Geesthacht, F.R. Germany (24 Sep 1984).

Thermally embrittled amorphous $Fe_{40}Ni_{40}B_{20}$ reveals a complete restoration of the ductility upon low dose neutron irradiation. The improvement of the ductility is studied both as a function of the damage type as caused either by thermal or by fast neutrons, and of the damage rate. While the damage rate has no influence, the type of irradiation strongly influences the damage level at which the ductility of amorphous $Fe_{40}Ni_{40}B_{20}$ is completely restored.

31448 (IA—1404, pp 220-221) **Ion implantation in metals.** Lempert, G.D.; Kanter, M. Jul 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85780940.

Published in summary form only.
In Research laboratories annual report 1983.

31449 (IA—1404, pp 110-111) **Structure of Rsub(1-x)Gasub(2(1+x)) (0<=x<=0.33) and its relation to RGa_6 and Ga.** Kimmel, G.; Dayan, D. (Israel Atomic Energy Commission, Tel Aviv); Zevin, L.; Pelleg, J. (Ben-Gurion Univ. of the Negev, Beersheba (Israel)). Jul 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85780940.

Published in summary form only.
In Research laboratories annual report 1983.

31450 (IA—1404, pp 112-113) **Tensile flow and fracture behavior of austenitic stainless steel after thermal aging in hydrogen atmosphere.** Rosenthal, Y.; Mark-Markowitch, M.; Stern, A. (Israel Atomic Energy Commission, Tel Aviv); Eliezer, D. (Ben-Gurion Univ. of the Negev, Beersheba (Israel)). Jul 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85780940.

Published in summary form only.
In Research laboratories annual report 1983.

31451 (IA—1404, pp 113-114) **Plastic flow and fracture of Ti-modified type-316 austenitic stainless steel after high temperature aging in hydrogen.** Mark-Markowich, M.; Rosenthal, Y.; Stern, A. (Israel Atomic Energy Commission, Tel Aviv); Eliezer, D. (Ben-Gurion Univ. of the Negev, Beersheba (Israel)). Jul 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85780940.

Published in summary form only.
In Research laboratories annual report 1983.

31452 (IA—1404, pp 115) **Mechanical properties of hydrogenated austenitic stainless steel.** Gilad, I.; Katz, Y.; Mathias, H. Jul 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85780940.

Published in summary form only.
In Research laboratories annual report 1983.

31453 (IA—1404, pp 115-116) **Hydrogen embrittlement of austenitic stainless steel (ASS) laser welds.** Simca, F.; Stern, A. (Israel Atomic Energy Commission, Tel Aviv); Eliezer, D. (Ben-Gurion Univ. of the Negev, Beersheba (Israel)). Jul 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85780940.

Published in summary form only.
In Research laboratories annual report 1983.

31454 (IA—1404, pp 116-117) **Transitions in fatigue processes at low temperature.** Katz, Y.; Bussiba, A.; Mathias, H. Jul 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85780940.

Published in summary form only.
In Research laboratories annual report 1983.

31455 (IA—1404, pp 109) **Coercivity and squareness ratio in Co-W thin films.** Admon, U.; Dariel, M.P.; Kimmel, G. (Israel Atomic Energy Commission, Tel Aviv); Greenbaum, E. (Tel Aviv Univ. (Israel)); Lodder, J.C. (Technische Hogeschool Twente, Enschede (Netherlands)). Jul 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85780940.

Published in summary form only.
In Research laboratories annual report 1983.

31456 (IA—1404, pp 109-110) **Irreversible magnetization in Co-W thin films.** Admon, U.; Dariel, M.P.; Kimmel, G. (Israel Atomic Energy Commission, Tel Aviv); Grunbaum, E. (Tel Aviv Univ. (Israel)). Jul 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85780940.

Published in summary form only.
In Research laboratories annual report 1983.

31457 (IAE—3774/11) **Role of mechanical stress in materials alloying by ion implantation.** Titov, V.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1983. 48p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. File Number DE85701035.

The generation of mechanical stresses in a solid by implantation alloying and other substantially nonequilibrium methods of implantation of impurity atoms are considered. The problems of mechanical strength of the alloyed layers, methods of excessive stresses release and the effect of these stresses on the redistribution of the implanted impurity are discussed. It has been found that in many cases the effect of strain-induced intruding of the impurity can play a noticeable role in shaping the profile of impurity distribution. This pertains to the implantation of ions of ultralow energies, implantation of great doses knocking in alloying, pulsed thermal treatment of implantation layers.

31458 (IAE—3815/10) **Investigation into temperature dependence of specific heat of $Zr_{70}Be_{30}$ superconductive system in amorphous and crystalline, states in the temperature range of 100 to 500 K.** Panova, G.Kh.; Chernoplekov, N.A.; Shikov, A.A.; Kemen', T.; Fogarashi, B.; Tsiraki, A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1983. 9p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85701033.

Thermal capacity of superconducting $Zr_{70}Be_{30}$ system in amorphous and metastable crystalline state in the range of 100-500 K is measured; kinetics of transition from amorphous phase into metastable and stable crystalline state is studied. It is shown that during amorphization Debye temperature THETAsub(BT) falls while the coefficient of electron thermal capacity rises, which is conditioned by moderation of phonon spectrum and increase in electron state density.

31459 (INDC(NDS)—128/GR) IAEA advisory group meeting on nuclear data for radiation damage assessment and related safety aspects, Vienna, 12-16 October 1981. Summary report. Kocherov, N. (ed.). (International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee). Jan 1982. 14p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85701036.

This advisory group meeting on nuclear data for radiation damage assessment and related safety aspects was convened by the IAEA Nuclear Data Section, at IAEA Headquarters in Vienna, Austria, from 12-16 October 1981. The meeting was attended by 34 participants from 15 countries and 2 international organizations. The main objective of the meeting was to review the requirements for and the status of nuclear data needed for radiation damage estimates in reactor structural materials and related reactor safety aspects, and to develop recommendations to the Nuclear Data Section of the IAEA for its future activities in this field.

31460 (INIS-mf—9294) Radiation damage in $Al^{57}Co$ caused by 25 MeV oxygen ions: Establishment of a dose curve on the basis of Moessbauer effect and resistance measurements. Zeman, N. (Erlangen-Nuernberg Univ., Erlangen (Germany, F.R.). Naturwissenschaftliche Fakultaet 1 - Mathematik und Physik). 13 Feb 1984. 73p. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE85780932.

With 65 refs.

Doped foils of aluminium with ^{57}Co have been irradiated, with O_3-ions of 25 MeV at a temperature of 100K. The Moessbauer effect and the electrical resistivity were investigated at 4,2 K in order to obtain valuable information on the behaviour of created point defects, e.g. the clustering of interstitials at Co-atoms and their dose dependence. It was found that clusters exceeding a critical size grow and do not anneal out contrary to the behaviour of smaller interstitial clusters. (orig.).

31461 (JAERI-M—83-224) Design fatigue curve for Hastelloy-X. Nishiguchi, Isoharu; Muto, Yasushi; Tsuji, Hirokazu. (Japan Atomic Energy Research Inst., Tokyo). Dec 1983. 44p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. File Number DE85701031.

In the design of components intended for elevated temperature service as the experimental Very High-Temperature gas-cooled Reactor (VHTR), it is essential to prevent fatigue failure and creep-fatigue failure. The evaluation method which uses design fatigue curves is adopted in the design rules. This report discussed several aspects of these design fatigue curves for Hastelloy-X (-XR) which is considered for use as a heat-resistant alloy in the VHTR. Examination of fatigue data gathered by a literature search including unpublished data showed that Brinkman's equation is suitable for the design curve of Hastelloy-X (-XR), where total strain range Δ epsilon sub(t) is used as independent variable and fatigue life Nsub(f) is transformed into log(log Nsub(f)).

31462 (JAERI-M—84-014) Low-cycle fatigue of Hastelloy X and Hastelloy XR in simulated VHTR helium coolant environment at elevated temperature. Tsuji, Hirokazu; Kondo, Tatsuo. (Japan Atomic Energy Research Inst., Tokyo). Feb 1984. 33p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. File Number DE85701032.

Strain-controlled low-cycle fatigue tests were conducted on Hastelloy X and its modified version, Hastelloy XR, at 900 sup(o)C in the flowing simulated VHTR helium environment. The results of this study provide the following conclusions; 1) Hastelloy X and Hastelloy XR exhibited essentially the same low-cycle fatigue characteristics under the given test conditions, where marked difference was observed in the oxidation performance between those materials. The results obtained in the present work were in good accordance with the following equation proposed by Manson and Coffin Δ epsilon sub(t) = Δ epsilon sub(e) + Δ epsilon sub(p) = 0.00228 Nsub(f)sup(-0.00732) + 0.447 Nsub(f)sup(-0.604) 2) The ratio of Nsup(f) in impure helium to Nsup(f) in 1–3 x 10^{-6} Pa vacuum were examined, and the results were equally about 0.7 for both materials. 3) Both transgranular fracture mode with ductile striations and intergranular fracture mode were recognized in the fracture surfaces, with the former mode being predominant. 4) The results obtained in the present work were situated on the line corresponding to the approximate average level of the available fatigue data in literature on Hastelloy X tested under similar test conditions.

31463 (Juel—1923) High-temperature helium embrittlement (T>=0,45Tsub(M)) of metals. Batfalsky, P. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Festkoerperforschung; Technische Hochschule Aachen (Germany, F.R.)). Jun 1984. 103p. (In German). NTIS (US Sales Only), PC A06/MF A01. File Number DE85751139.

Thesis.

High temperature helium embrittlement, swelling and irradiation creep are the main technical problem of fusion reactor materials. The expected helium production will be very high. The helium produced by (n,α)-processes precipitates into helium bubbles because its solubility in solid metals is very low. Under continuous helium production at high temperature and stress the helium bubbles grow and lead to intergranular early failure. Solution annealed foil specimens of austenitic stainless steel AISI 316 were implanted with α-particles: 1. during creep tests at 1023 K (in-beam test) 2. before the creep tests at high temperature (1023 K). The creep tests have been performed within large ranges of test parameter, e.g. applied stress, temperature, helium implantation rate and helium concentration. After the creep tests the microstructure was investigated using scanning (SEM) and transmission (TEM) electron microscopy. All the helium implanted specimens showed high temperature helium embrittlement, i.e. reduction of rupture time tsub(R) and ductility epsilonsub(R) and evidence of intergranular brittle fracture. The in-beam creep tests showed greater reduction of rupture time tsub(R) and ductility than the preimplanted creep tests. The comparison of this experimentally obtained data with various theoretical models of high temperature helium embrittlement showed that within the investigated parameter ranges the mechanism controlling the life time of the samples is probably the gas driven stable growth of the helium bubbles within the grain boundaries.

31464 (Juel—1939) Effect of test atmosphere on the formation and propagation of creep cracks in commercial high temperature alloys. Yun, H.M.; Schuster, H.; Ennis, P.J.; Nickel, H. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorwerkstoffe und Heisse Zellen; Technische Hochschule Aachen (Germany, F.R.)). Jul 1984. 197p. (In German). NTIS (US Sales Only), PC A09/MF A01. File Number DE85751128.

Thesis by H.M. Yun.

The influence of surface cracks caused by corrosion on the creep rupture properties of the alloys INCOLOY 800H and INCONEL 617 has been investigated for temperatures in the range 1073 K to 1223 K. The test environments were air and impure helium simulating the primary coolant gas of a high temperature reactor (HTR helium). The depths of surface cracks in creep test specimens were measured metallographically and a characteristic crack depth, a_{90}, was derived. a_{90} is defined so that 90% of the cracks present have depths below a_{90}. The dependence of a_{90} on test time, creep strain and stress was examined. The growth of creep cracks at the specimen surface as a function of the creep strain was described analytically. This allowed the stress increase due to loss of specimen cross section by surface crack formation to be estimated. It was shown that the surface cracks resulting from corrosion lead to an increase in the creep rate at creep strains above 5%, but the increases were similar in both atmospheres. Rupture of the specimens occurred when the surface cracks and voids developed inside the specimen due to the creep damage processes. This is the main reason for the similar creep rupture properties of the alloys in the two test environments. Finally, a method has been developed to allow the plotting of the depth of surface cracks caused by corrosion with the stress-rupture curves. In this type of diagram, the damage resulting from surface cracks can be related to the creep rupture data to indicate whether corrosion effects need to be considered in the derivation of design stresses.

31465 (KFK—3802) **Examination of transpassive nitric acid corrosion behavior of different austenitic stainless steels by prolongated Huey-testing (65% HNO_3, 120°C, 720 h).** Kraft, R.; Leistikow, S.; Pott, E. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Wiederaufarbeitung und Abfallbehandlung). Nov 1984. 99p. (In German). (PWA—74/84). NTIS (US Sales Only), PC A05/MF A01. File Number DE85751134.

The aim of these experiments was to test the quality and the ability to longtime service conditions of various austenitic stainless steels of type CrNi1810 CrNi 2520 by ASTM Standard Huey-Test, prolongated up to 15 periods of 48 h each. By gravimetry the rate of metal loss, by metallography the maximum depth of local dissolution, by microscopy the overall appearance of the corroded surface was checked and evaluated. The best corrosion behavior was shown by the low carbon 2520 CrNi stainless steels in the fine-grain, highly pure, solution annealed condition, not showing any trend to accelerated corrosion when sensitizing heat treatment or long-time exposure were applied. The prolonged Huey-Test proved to be a sensitive method to evaluate the corrosion behavior of steels for engineering purposes, especially the effects caused by the main alloy components, small impurity concentrations, and differences in homogenity of the bulk structure. Thus, in combination with the evaluation of local intercrystalline dissolution (penetration) in the metallographic cross-section, differences in quality can be determined and long-term loss of wall thickness roughly estimated. 26 figures.

31466 (KFK—3819) **Experiments for liquid metal embrittlement of fusion reactor materials by liquid lithium.** Grundmann, M.; Borgstedt, H.U. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Material- und Festkoerperforschung; Kaiserslautern Univ. (Germany, F.R.)). Oct 1984. 195p. (In German). NTIS (US Sales Only), PC A09/MF A01. File Number DE85751132.

Thesis.

The liquid metal embrittlement behaviour of two martensitic-ferritic steels [X22CrMoV121 (Nr. 1.4923) and X18CrMoVNb 121 (Nr. 1,4914)] and one austenite chromium-nickel-steel X5CrNi189 (Nr. 1.4301) was investigated. Tensile tests in liquid lithium at 200 and 250°C with two different strain rates on precorroded samples (1000 h at 550°C in lithium) were carried out. Reference values were gained from tensile tests in air (RT, 250°C). It is concluded that there is sufficient compatibility of the austenitic steel with liquid lithium. The use of the ferritic-martensitic steels in liquid lithium on the other hand, especially at temperatures of about 550°C, seems to be problematic. The experimental results led to a better understanding of LME, applying the theory of this material failure.

31467 (LA-UR—85-1648) **Superconductivity in the W-Tc and W_2C-Tc systems.** Giorgi, A.L. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 11p. (CONF-8505138—4). NTIS, PC A02/MF A01; GPO Dep. File Number DE85012711.

From Materials and mechanisms of superconductivity conference; Ames, IA, USA (29 May 1985).

A series of compositions in the W-Tc, W_2C-Re and W_2C-Tc systems were prepared and examined for superconductivity. The crystal structure, lattice parameters and superconducting transition temperatures of the W_2C-Tc are reported for the first time. Similar measurements were made on the W-Tc and W_2C-Re systems and the results compared with previous published results for these systems. 7 refs., 2 figs., 2 tabs.

31468 (LBL—18457) **Near-threshold fatigue: an overview of the role of microstructure and environment.** Ritchie, R.O. (Lawrence Berkeley Lab., CA (USA)). Sep 1984. Contract AC03-76SF00098. 64p. (CONF-8409121—2). NTIS, PC A04/MF A01; GPO Dep. File Number DE85009903.

From 2. international conference on fatigue thresholds - Fatigue 84; Birmingham, UK (3 Sep 1984).

An overview is presented of the salient micro-mechanisms, primarily involving crack closure, which can influence the growth of fatigue cracks at near-threshold levels. Examples are drawn from recent work on crack propagation in dual-phase and low alloys steels and in under/peak/overaged aluminium alloys. Factors such as duplex microstrucures, variations in slip mode, high pressure hydrogen environments and compression overloads are shown to modify changes in near-threshold crack growth behavior.

31469 (LBL—19286) **Atomic mechanisms of γ′ precipitate plate growth in the Al-Ag system.** Howe, J.M. (Lawrence Berkeley Lab., CA (USA)). Mar 1985. Contract AC03-76SF00098. 324p. NTIS, PC A14/MF A01; 1; GPO Dep. File Number DE85012558.

Energy-dispersive x-ray spectroscopy results that the precipitates have the composition Ag_2Al. High-resolution electron microscopy of γ′ precipitates in both <110>//<1120> and <111>//<0001> orientations shows that all interfaces of the precipitate are largely coherent with the matrix and are faceted along low-energy (111) and (110) matrix plans, due to the influence of surface and elastic strain energies on the transformation. Further comparison between experimental and calculated high-resolution images of the precipitate/matrix interface and of Shockley partial dislocation ledges on the precipitate faces demonstrates that both thickening and lengthening of γ′ precipitate plates occurs by the passage of the Shockley partial dislocations along alternate (111) matrix planes by a terrace-ledge-kink mechanism. These images and electron diffraction information also indicate that the γ′ precipitates are ordered, where the A-planes in the precipitate contain nearly pure Ag and the B-planes have the composition Al_2Ag, and that the limiting reaction in the growth process is the substitutional diffusion of Ag cross kinks in the Shockley partial dislocations, which terminate in the Ag-rich A-planes. The terraces between ledges are atomically flat and ledges are uniformly stepped-down from the centers to the edges of isolated precipitates. Convergent-beam electron diffraction (CBED) analyses of γ′ precipitates indicate that they have the space group $P6_3$/mmc. Effect of specimen thickness on symmetry determinations by CBED was also examined for an α-titanium sample. Results show that the symmetries observed in CBED patterns from thin specimens may be due to the limited thickness of the specimen, rather than to the actual space group of the material.

31470 (NAC-AR—84-01, pp 229) **Report of the Van de Graaff Group: solid state and materials research. Heat flow in solids during pulsed laser irradiation.** Allie, M.S.; Pretorius, R.; Simpson, M.O.; Pilchner, J.; Perold, W. (Stellenbosch Univ. (South Africa). Dept. of Electrical Engineering). 1984. NTIS (US Sales Only), PC A14/MF A01. File Number DE85780939.

Short note.

In Annual report June 1984. [Council for Scientific and Industrial Research, Faure (South Africa). National Accelerator Center].

31471 (NUREG/CR—3900-Vol.3) **Long-term performance of materials used for high-level waste packaging. Third quarterly report, Year Three, October-December 1984. Vol. 3.** Stahl, D.; Miller, N.E. (comps.). (Battelle Columbus Labs., OH (USA)). May 1985. 82p. NTIS, PC A05/MF A01 - GPO. File Number TI85901514.

As part of the Nuclear Regulatory Commission's requirement to assess the Department of Energy's application to construct geologic repositories for storing high-level radioactive waste, Battelle's Columbus Laboratories is investigating the long-term performance of materials used for high-level waste packaging. Experiments for evaluating the glass-dissolution model are under way, and the procedure developed last quarter for dispersing RuO_2 in MCC 76-68 glass has been tested and proved to produce appropriate particle concentrations. Acetic and humic acids have been chosen to test the effect of natural organic acids on waste-glass performance. In the overpack-corrosion effort, potentiodynamic polarization tests indicate that of the 15 chemical species tested, all but perchlorate and hydrogen may affect stress-corrosion cracking behavior of carbon steel; several synergistic effects were also indicated. In slow strain rate studies, specimens tested in 0.0005 M $FeCl_3$ (a much lower chloride concentration than expected in groundwater) exhibited significant cracking over the temperature range 250 to 315°C. Pits were found to propagate readily, but slowly, in 1018 carbon steel exposed to aerated basalt groundwater at 90°C. The general-corrosion correlation was changed to incorporate a finite rate of film growth. Integral experiments are being prepared to provide information on combined-effects processes that may influence the long-term performance of the waste package. 26 refs., 17 figs., 16 tabs.

31472 (NUREG/CR—4092) **ORNL characterization of Heavy-Section Steel Technology Program plates 01, 02, and 03.** Stelzman, W.J.; Berggren, R.G.; Jones, T.N. Jr. (Oak Ridge National Lab., TN (USA)). Apr 1985. Contract AC05-84OR21400. 168p. (ORNL/TM—9491). NTIS, PC A08/MF A01 - GPO. File Number TI85011249.

Charpy V-notch impact, tensile, and drop-weight data are presented for three 305-mm-thick (12-in.) A 533 grade B class 1 steel plates. The effects of specimen size and orientation were examined as well as the variation of properties between different plate locations and depths. Some observations based on data obtained from an instrumented Charpy testing machine are also presented.

31473 (ORNL/TM—9573) **Characterization of modified 9 Cr-1 Mo steel sand castings.** Sikka, V.K. (Oak Ridge National Lab., TN (USA)). Apr 1985. Contract AC05-84OR21400. 33p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85012057.

Experience with the sand casting of modified 9 Cr-1 Mo steel at several foundries is presented. The castings included simple blocks, elbows, valve bodies, and a steam chest. Castings were characterized by tensile and Charpy impact tests, for the effects of thermal aging on Charpy impact properties and hardness, and by creep, fatigue, and microstructure. Properties of the castings were compared with those observed for wrought material. In general, mechanical properties of castings were slightly lower than those of the wrought material.

31474 (OUEL-R—1309/80) **Effect of strain rate and temperature on the tensile behaviour of uranium - 2sup(w)/o molybdenum.** Harding, J.; Boyd, G.A.C. (Oxford Univ. (UK). Dept. of Engineering Science). 1983. 19p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85701455.

This report describes the uniaxial tensile behaviour of uranium 2 w/o molybdenum alloy over a wide range of temperature and strain rate. Specimen blanks taken from co-reduced and extruded U2 w/o Mo rods were given one of two heat treatments. Longitudinal tensile test pieces, taken from these blanks at near surface locations were tested in the temperature range -150 deg C to +100 deg C at strain rates from quasistatic (10^{-4} s^{-1}) to 10^{3} s^{-1}. To achieve this range of testing rates three machines were required: an Instron screw driven machine for rates up to 0.1 s^{-1}, a second specially constructed hydraulic machine for the range 0.1 s^{-1} to 50 s^{-1} and a drop weight machine for the highest strain rates. The ways in which the mechanical properties - elongation to fracture, flow stresses and ultimate tensile stress - vary with both temperature and strain rate are presented and discussed for material in both heat treatment conditions.

31475 (OUEL-R—1492/83) **Effect of cooling rate from the γ-phase on the strain-rate sensitivity of a uranium 2 sup(w)/o molybdenum alloy.** Boyd, G.A.C.; Harding, J. (Oxford Univ. (UK). Dept. of Engineering Science). 1983. 51p. NTIS (US Sales Only), PC A04/MF A01. File Number DE85701456.

Tensile tests have been performed at strain rates from 10^{-4} to about 2000/s and temperatures from -150 deg C to +250 deg C on a uranium 2 w/o molybdenum alloy which had been aged for 2 hours at 500 deg C after a fast gas cool from the γ-phase at a controlled rate of 40 deg C/minute. The results are compared with those for standard as-extruded material which had received the same aging treatment. Stress-strain curves are presented and the effect of strain rate and temperature on the flow stress, the ultimate tensile stress and the elongation to fracture is determined. A thorough structural characterisation of the specimen materials, using X-ray analysis and scanning and transmission electron microscopy, allows the different mechanical responses to be related to the corresponding microstructural state of the material. Flow stress data at different temperatures and strain rates are analysed in terms of the theory of thermally-activated flow and estimates made of the various activation parameters.

31476 (RFP—3728) **Interaction of trace elements and welding parameters on GTA weld shape.** Burgardt, P.; Heiple, C.R. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). [1985]. Contract AC04-76DP03533. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85004046.

Good penetration and poor penetration steels have different responses to changes in temperature distribution on the weld pool surface. Penetration of 304 SS was varied using S and Se dopants. The weld parameter investigated was the electrode tip angle. Results of bead-on-plate GTA welds show that there is a difference in response of weld pool shape to tip angle depending on penetration: Low penetration base metal showed no dependence, intermediate penetration steel showed a small linear decrease of weld depth-to-width ratio (d/w) with tip angle, while high penetration steel showed an increase of d/w up to a maximum at about 50°, followed by a decrease in d/w. (DLC)

31477 (RHO-RE-ST—31P) **Review of zirconium-zircaloy pyrophoricity.** Cooper, T.D. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Nov 1984. Contract AC06-77RL01030. 28p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85011169.

Massive zirconium metal scrap can be handled, shipped, and stored with no evidence of combustion or pyrophoricity hazards. Mechanically produced fine scrap such as shavings, turnings, or powders can burn but are not pyrophoric unless the particle diameter is less than 54 μm. Powders with particle diameters less than 54 μm can be both pyrophoric and explosive. Pyrophoric powders should be collected and stored underwater or under inert gas cover to reduce the flammability hazard. Opening sealed containers of zirconium stored underwater should be attempted with caution since hydrogen may be present. The factors that influence the ignition temperature have been explored in depth and recommendations are included for the safe handling, shipping, and storage of pyrophoric or flammable zirconium. 29 refs., 5 figs., 6 tabs.

31478 (SAND—84-1876-Vol.1, pp 211-234) **Effect of titanium content on quench rate sensitivity and aging response in U-Ti alloys.** Eckelmeyer, K.H.; Chapman, L.R.; Romig, A.D. Jr. (Sandia National Labs., Albuquerque, NM). Jan 1985. No Distribution. Refer request to Sandia. File Number TI85027162. (CONF-8310370—Vol.1). Contract AC04-76DP00789.

From JOWOG 22 uranium alloy meeting; Albuquerque, NM, USA (11 Oct 1983).

The critical quench rate required to suppress diffusional decomposition of the γ-phase and obtain martensitic microstructures varies dramatically with titanium content. The microstructures and mechanical properties of very rapidly quenched material also vary substantially with Ti content. Very rapidly quenched materials are age hardenable, and the extent of aging response increases with increasing amount of martensite. Tensile tests on material that was age hardened after being fully quenched indicate that the best combinations of yield strength and ductility can be obtained in the higher titanium alloys. Quench rate sensitivity problems, however, will restrict applications of these alloys to very thin sections. For most applications it appears that titanium contents in the 0.6 to 0.75% range offer the best combinations of quenchability and mechanical properties.

31479 (SAND—84-1876-Vol.1, pp 235-248) **Computer simulations for predicting the quench behavior of uranium and uranium-0.75 titanium alloys.** Ludtka, G.M.; Chapman, L.R.; Llewellyn, G.H. (Oak Ridge Y-12 Plant, TN). Jan 1985. No Distribution. Refer request to Sandia. File Number TI85027162. (CONF-8310370—Vol.1). Contract W-7405-ENG-26.

From JOWOG 22 uranium alloy meeting; Albuquerque, NM, USA (11 Oct 1983).

One- and two-dimensional (R,Z) models for the analysis of the quenching behavior of uranium have been generated. These models incorporate the temperature-dependent heat transfer and thermophysical properties, and stress the importance of the enthalpy of transformation. The latter has been shown to contribute as much as one third of the heat that must be removed upon quenching. In addition, local increases in temperature which can alter the final microstructure and residual stress can be predicted by the computer simulation by taking into account phase transformation effects. The results and implications of this research endeavor will be reviewed. In addition, current efforts to expand the modeling to three dimensions and to the uranium-0.75 titanium (U-0.75Ti) alloy will be outlined. The goal of this research is to develop the ability to predict the final microstructure and residual stress profile for specific quenching techniques and part geometries.

31480 (SAND—84-1876-Vol.1, pp 249-257) **Effect of cold work on the tensile properties of U-2 Mo.** Edwards, K.L.; Turner, G.I.; Dunn, M.K. (Atomic Weapons Research Establishment, Aldermaston, England). Jan 1985. No Distribution. Refer request to Sandia. File Number TI85027162. (CONF-8310370—Vol.1).

From JOWOG 22 uranium alloy meeting; Albuquerque, NM, USA (11 Oct 1983).

Cast co-reduced depleted U-2 Mo was extruded in a copper sheath at 850°C through a 35 mm die (17:1 ratio) to provide bar stock for this study. De-clad sections of bar were vacuum heat treated at 800°C for 3 h, fast gas quenched in recirculating argon and aged 2 h at 500°C (AWRE HT2). The bar lengths were then cold swaged from 32 mm dia to various area reductions in the range 9% to 36%, in single and two stages. This material was evaluated for both hardness and quasistatic tensile properties. The UTS increases smoothly with increasing amounts of area reduction from 163 kpsi at zero reduction to 221 kpsi at 32% area reduction. Beyond this, at 36% reduction, the strength is reduced. As expected there is a concurrent decrease in tensile elongation, which falls rapidly from the unworked level of ~12% to ~3% at 10% area reduction. The Vickers hardness/degree of swaging relationship is a smooth curve of similar form to the UTS - cold work curve, the hardness rising smoothly from 366 VPN to a peak of 391 VPN at 32% cold work. In order to improve the strength/ductility combinations achieved by cold work tensile blanks at the 14% and 22% levels were stress relieved by vacuum heat treatment at selected points within a matrix bounded by times from 2 h to 16 h and temperatures from 250° to 500°C. For both levels of cold work there is no significant change in either UTS or elongation after treatment at temperatures up to 400°C. At 500°C however the anticipated recovery of ductility is observed, but with some loss of strength.

31481 (SAND—84-1876-Vol.1, pp 258-270) **Isothermal time-temperature-transformation diagram for the uranium-6 niobium alloy.** Vandermeer, R.A. (Oak Ridge Y-12 Plant, TN). Jan 1985. No Distribution. Refer request to Sandia. File Number TI85027162. (CONF-8310370—Vol.1). Contract W-7405-ENG-26.

From JOWOG 22 uranium alloy meeting; Albuquerque, NM, USA (11 Oct 1983).

A wide variety of mechanical properties can be produced in the uranium-6 niobium (U-6Nb) alloy by heat treatment. Knowledge about the nature of the aging reactions below 400°C is lacking. In this study, dilatometry was used to measure the isothermal kinetics of the aging reactions at temperatures between 203° and 585°C. At least three aging phenomena were identified. A classical cellular or discontinuous precipitation was found at temperatures between 500° and 585°C. Two superimposed aging phenomena were observed between 203° and 350°C. One was attributed to a solute-clustering phenomenon, the other to the formation of an isothermal α'' martensite. The kinetics of each of these aging processes was described by an equation of the Avrami type. Reaction constants were calculated from analysis of length change data obtained at each temperature and a time-temperature-transformation diagram was constructed.

31482 (SAND—84-1876-Vol.1, pp 271-313) **Phenomenological diffusion behavior and diffusion leveling in U-Nb alloys.** Romig, A.D. Jr. (Sandia National Labs., Albuquerque, NM). Jan 1985. No Distribution. Refer request to Sandia. File Number TI85027162. (CONF-8310370—Vol.1). Contract AC04-76DP00789.

From JOWOG 22 uranium alloy meeting; Albuquerque, NM, USA (11 Oct 1983).

Diffusion behavior in γ-phase U-Nb has been investigated in the temperature range 800 to 1000°C. Above 977°C a continuous bcc solid solution exists between U and Nb. Below this temperature a solid state miscibility gap exists between the bcc U-rich γ_1, and the bcc Nb-rich γ_2. The intrinsic diffusion coefficients (D/sub Nb/ and D/sub U/) and the chemical diffusion coefficient (~D) were investigated via a Kirkendall/Darken experiment. The activation energy (~Q) was found to vary with composition, being a maximum of ~ 600 kj/mole in γ_2 and decreasing to a minimum of ~ 125 kj/mole in γ_1, which agrees with the results of Peterson and Ogilvie. D/sub Nb/ and D/sub U/ could not be determined explicitly. These results were applied to process induced Nb segregation found in cast, wrought, and powder processed U-6 Nb alloys. The time-temperature dependence of the diffusion leveling reaction has been modeled with a finite difference algorithm. This scheme allows for the calculation of the heat treatment schedules required to level a given initial amount of segregation.

31483 (SAND—84-1876-Vol.1, pp 326-329) **Effect of temperature and texture on the Charpy impact energy of uranium.** Wood, D.H. (Lawrence Livermore National Lab., CA). Jan 1985. No Distribution. Refer request to Sandia. File Number TI85027162. (CONF-8310370—Vol.1).

From JOWOG 22 uranium alloy meeting; Albuquerque, NM, USA (11 Oct 1983).

The author unidirectionally rolled derby grade uranium from cast 2" slabs down to half-inch in thickness at two different temperatures: 630C and 250C. At the lower temperature an intermediate 630C salt bath anneal was required. During rolling the 630C came from a salt bath, and the 250C from an open furnace flushed with argon. A portion of the material rolled at 630C was double β quenched, cut into specimen blanks, and then heated in a high vacuum to 550C for 4 hours. The other, as-rolled, plates were cut into blanks and these blanks were annealed in a high vacuum for 4 hours at 500C, the furnace was then cooled to 425C and the anneal continued for 50 hours before cooling under vacuum. The blanks has been cut from the plates at various angles relative to the rolling direction, and Charpy bars machined therefrom were broken at various temperatures. With material produced by the low temperature rolling, fracture transition was found to be about 50C lower when the fracture path was in the rolling direction (0°) than when it was in the transverse direction (90°). With the 630C rolled material the results were not as simple, but it did appear that the lowest temperature transition behavior resulted when the fracture was at 45° to the rolling direction, and the highest temperature transition behavior resulted when the fracture was in the rolling direction. Thus the transition behavior, when measured in this way, contrasted as a result of the texture produced at each rolling temperature. The double β quenched plate had a larger grain size, yet showed the lowest transition temperature of all. Lacking a rolling texture, this material did not vary as a function of fracture direction.

31484 (SAND—84-1876-Vol.1, pp 330-343) **Properties and aging characteristics of UK and US produced U-6% Nb.** Moules, T.R.; Badger, G.S. Jan 1985. No Distribution. Refer request to Sandia. File Number TI85027162. (CONF-8310370—Vol.1).

From JOWOG 22 uranium alloy meeting; Albuquerque, NM, USA (11 Oct 1983).

This paper describes the program of work to compare the physical and mechanical properties developed in aging quenched samples of extruded UK and US produced U-6% Nb. A U-6% Nb billet has been prepared in the UK by the co-reduction of UF_4 and K_2NbF_7 with Mg, followed by vacuum induction melting. A small extrusion billet was machined from the cast billet and extruded along with a similar sized, vacuum arc melted billet produced in the US. Mechanical properties for the alloys are reported and compared against the usual aging parameters. These plots show the increase in strength and hardness and reduction in ductility as aging proceeds. Peak strengths and minimum ductility levels are reached at about 400 - 450°C. The UK alloy did not achieve peak tensile strength but this was probably due to its poor quality. Over aging coincides with decreases in strength and hardness and increases in ductility. The generally lower properties exhibited by the UK alloy compared with the US alloy can be directly attributed to differences in composition and quality of the castings. In general both the UK and US alloys exhibit similar aging characteristics with the banded α'' giving way to grain boundary and inclusion reaction products on increase in aging temperature. At temperatures of 550°C for the UK alloy and 500°C and 550°C for the US alloy the grain structure appears masked by the $\alpha + \gamma$ matrix phase. Over aging causes secondary recrystallization and precipitation at grain boundaries.

31485 (SAND—84-1876-Vol.1, pp 314-325) **Linear coefficients of thermal expansion of the uranium-6 niobium alloy between -50° and +150°C: effects of processing variables.** Vandermeer, R.A. (Oak Ridge Y-12 Plant, TN). Jan 1985. No Distribution. Refer request to Sandia. File Number TI85027162. (CONF-8310370—Vol.1). Contract W-7405-ENG-26.

From JOWOG 22 uranium alloy meeting; Albuquerque, NM, USA (11 Oct 1983).

The effects of metallurgical variables on the coefficients of thermal expansion (CTE) of a uranium-6 niobium (U-6Nb) alloy between -50° and +150°C have been studied using a quartz differential, double push rod dilatometer. The CTE was observed to be a complex function of temperature, and metallurgical history had a profound influence on CTE especially at 150°C where values ranged from a low of $5.56 \times 10^{-6}\,{}^{\circ}C^{-1}$ to a high of $19.50 \times 10^{-6}\,{}^{\circ}C^{-1}$. Even at room temperature the observed maximum and minimum CTE were $13.90 \times 10^{-6}\,{}^{\circ}C^{-1}$ and $9.52 \times 10^{-6}\,{}^{\circ}C^{-1}$, respectively. The metallurgical variables that were studied were: 1) cooling rate from the solution heat treatment temperature; 2) aging at 200°C; 3) machining; 4) thermal cycling between 100°C and -196°C; and 5) electropolishing. In general, the machined specimens had the lowest CTE and the severely quenched and the quenched-and-aged specimens had the highest CTE. The wide disparity of CTE values at 150°C can be attributed to the nature of the stress states imposed during processing and the fact that the alloy undergoes a partial phase transformation (reversion of the α'' martensite) between room temperature and 150°C. A theory of CTE for (U-6Nb) has been outlined but many of the parameters in the theory have never been measured.

31486 (SAND—84-1876-Vol.1, pp 375-380) **Permeation of hydrogen through nickel electroplate.** Anthony, S.R.; Finnerty, P. (Atomic Weapons Research Establishment, Aldermaston, England). Jan 1985. No Distribution. Refer request to Sandia. File Number TI85027162. (CONF-8310370—Vol.1).

From JOWOG 22 uranium alloy meeting; Albuquerque, NM, USA (11 Oct 1983).

The rate of permeation of hydrogen through 75 μm of nickel electroplate on uranium has been measured as a function of pressure at 25°C. Permeation was observed to occur readily at this temperature and a $p^{0.6-0.7}$ rate dependence was observed to apply. The possible impairment of the substrate material with time as a result of permeation processes was studied at both slow ($10^{-3}s^{-1}$) and fast ($10^{3}s^{-1}$) strain rates up to hydrogen flux level of 0.3ml cm^{-2}. Progressive embrittlement was detected with increasing flux level at the slow strain rate, but no such effect was determined at high strain rates.

31487 (SAND—84-1876-Vol.1, pp 344-374) **Overview of corrosion, corrosion protection, and stress-corrosion cracking of uranium and uranium alloys.** Koger, J.W. (Oak Ridge Y-12 Plant, TN). Jan 1985. No Distribution. Refer request to Sandia. File Number TI85027162. (CONF-8310370—Vol.1). Contract W-7405-ENG-26.

From JOWOG 22 uranium alloy meeting; Albuquerque, NM, USA (11 Oct 1983).

The types of corrosion, forms of corrosion, principal conditions causing corrosion, and the factors affecting corrosion of metals in general are presented. General corrosion, pitting, and stress-corrosion cracking of uranium-niobium alloys, uranium-titanium alloys, uranium-molybdenum alloys, and other uranium alloys are discussed. Effects of aqueous and gaseous environments are given along with possible protection methods.

31488 (SAND—84-1876-Vol.1, pp 381-385) **Corrosion of unalloyed uranium in moist nitrogen.** Anthony, S.R.; Finnerty, P. (Atomic Weapons Research Establishment, Aldermaston, England). Jan 1985. No Distribution. Refer request to Sandia. File Number TI85027162. (CONF-8310370—Vol.1).

From JOWOG 22 uranium alloy meeting; Albuquerque, NM, USA (11 Oct 1983).

The rate of oxidation of unalloyed uranium has been investigated at two humidities (20% RH and 50% RH) in nitrogen at 25, 40 and 60°C. The oxidation rate was observed to vary considerably between specimens in the early stages of oxidation, but to become more uniform once linear kinetics had been established. Experiments at 40 and 60°C showed the presence of carbon dioxide in the environment did not influence the corrosion process. A separate experiment was conducted at 25°C to determine the influence of sustained vibration (5 - 100 Hz) upon corrosion behavior. No significant effect was detected.

31489 (SAND—84-1876-Vol.1, pp 386-390) **Corrosion and stress corrosion of as quenched U-6Nb alloy.** Anthony, S.R.; Bacon, R. (Atomic Weapons Research Establishment, Aldermaston, England). Jan 1985. No Distribution. Refer request to Sandia. File Number TI85027162. (CONF-8310370—Vol.1).

From JOWOG 22 uranium alloy meeting; Albuquerque, NM, USA (11 Oct 1983).

The corrosion response of as-quenched U-6Nb alloy has been investigated in both moist air and moist nitrogen environments, and stress corrosion data obtained in moist air and NaCl. The alloy was found to be extremely oxidation resistant, exhibiting a corrosion resistance at least two orders of magnitude greater than unalloyed uranium in both environments. Stress corrosion experiments have been carried out in normal laboratory air (30-40%RH), 100%RH air and NaCl. No detectable susceptibility was observed at the lower humidities but clear evidence was obtained in both 100%RH and NaCl environments. The mechanical properties of the U-6Nb alloy were found to be unaffected by storage at 75°C in either test environments for periods of up to three months.

31490 (SAND—84-1876-Vol.1, pp 391-415) **Oxidation of uranium in low partial pressures of oxygen and water vapor at 100°C.** Weirick, L.J. (Sandia National Labs., Albuquerque, NM). Jan 1985. No Distribution. Refer request to Sandia. File Number TI85027162. (CONF-8310370—Vol.1).

From JOWOG 22 uranium alloy meeting; Albuquerque, NM, USA (11 Oct 1983).

Unalloyed uranium, D-38, was oxidized at 100°C in atmospheres containing low partial pressures of oxygen with and without water vapor and also containing low partial pressures of water vapor with and without oxygen. Results on reaction rates and reaction products are presented.

31491 (UCID—20172) **Potential corrosion and degradation mechanisms of Zircaloy cladding on spent nuclear fuel in a tuff repository.** Rothman, A.J. (Lawrence Livermore National Lab., CA (USA)). Sep 1984. Contract W-7405-ENG-48. 53p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85003996.

A literature review and analysis were made of corrosion and degradation processes applicable to Zircaloy cladding on spent nuclear fuel in a tuff repository. In particular, lifetime sought for the Zircaloy is 10,000 years. Among the potential failure mechanisms examined were: oxidation by steam, air, and water, including the effects of ions whose presence is anticipated in the water; mechanical overload; stress (creep) rupture; stress-corrosion cracking (SCC); and delayed failure due to hydride cracking. The conclusion is that failure due to oxidation is not credible, although a few experiments are suggested to confirm the effect of aqueous fluoride on the Zircaloy cladding. Mechanical overload is not a problem, and failure from stress-rupture does not appear likely based on a modified Larson-Miller analysis. Analysis shows that delayed hydride cracking is not anticipated for the bulk of spent fuel pins. However, for a minority of pins under high stress, there is some uncertainty in the analysis as a result of: (1) uncertainty about crack depths in spent fuel claddings and (2) the effect of slow cooling on the formation of radially oriented hydride precipitates. Experimental resolution is called for. Finally, insufficient information is currently available on stress-corrosion cracking. While evidence is presented that SCC failure is not likely to occur, it is difficult to demonstrate this conclusively because the process is not clearly understood and data are limited. Further experimental work on SCC susceptibility is especially needed.

31492 (UCRL—15666) Shape memory effect in uranium-niobium alloys below room temperature. Final report. Vandermeer, R.A. (Tennessee Univ., Knoxville (USA)). Mar 1985. Contract W-7405-ENG-48. 26p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85012964.

The temperature dependence of the martensitic γ^0 to α^{11} phase transformation between 25°C and -198°C in water-quenched uranium-niobium alloys between 6.2 and 7.0 wt % niobium was determined using cold-stage x-ray diffraction experiments. Lowering the temperature promoted the transformation to α^{11} but complete transformation was never observed. The transformation was reversible with little or no hysteresis. Aging the alloys for two hours at 200°C stabilized the γ^0 phase and retarded the martensitic transformation. The compositions where M/sub s/ and M/sub f/ equaled room temperature were 5.80 and 7.04 wt % Nb respectively. At -196°C these values were approximately 0.25 wt % higher. Two alloys were selected as potential candidates for a uranium alloy clamp.

31493 (Y/DV—427) Experimental attempt to achieve microstructure variations through temperature/time permutations for a nonwrought powder metallurgy uranium-6 niobium alloy. Alexander-Morrison, G.M. (Oak Ridge Y-12 Plant, TN (USA)). 7 Jun 1985. Contract AC05-84OS21400. 25p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85013166.

The powder metallurgical processing of uranium-6 niobium (U-6Nb) alloy has undergone 3 years of characterization at the Oak Ridge Y-12 Plant. The current structure of the powder metallurgy (P/M) alloy has been described as duplex: a mixture of two or more distinct grain sizes. An experiment was conducted to determine a gamma stabilizing heat treatment (time and temperature combination) to produce a structure consisting of one gamma grain size. Two heat treatments were found to produce an irregular ASTM 4 grain size. Additional P/M U-6Nb alloy material was hot pressed and characterized using the two new heat treatments; however, the resulting microstructures were size ASTM 8. Mechanical properties of the fine-grained P/M material were characterized. Continued evaluation of these results did not determine the cause of the grain refinement.

31494 (ZfK—527) Adsorption of metals on metal surfaces and the possibilities of its application in nuclear chemistry. Calculation of adsorption enthalpies with the program AMO. Rossbach, H.; Eichler, B. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). Jun 1984. 20p. (In German). NTIS (US Sales Only), PC A02/MF A01. File Number DE85701034.

The differential enthalpies of adsorption of gaseous metals on the surface of solid metals have been calculated with the program AMO. The enthalpies of adsorption are evaluated as a function of the desublimation enthalpy, the first solution enthalpy of the solid adsorbate into solid adsorbent, and the displacement energy required for the production of solid solutions. The calculated values of the adsorption enthalpies of 63 adsorbates on the surface of the adsorbents: Ti, Fe, Ni, Cu, Zr, Nb, Mo, Rh, Pd, Ag, Ta, W, Re, Ir, Pt, Au as well as Al, Si, Zn, Ge, Cd, Pb are listed in tables. The program enables to investigate the effect of several parameters on the partial molar adsorption enthalpy and to estimate unknown parameters from the experimental partial molar adsorption enthalpy.

31495 Real time measurement of deposition initiation and rate in laser chemical vapor deposition. Allen, S.D.; Jan, R.Y.; Mazuk, S.M.; Vernon, S.D. (Center for Laser Studies, University of Southern California, Los Angeles, California 90089-1112). *Journal of Applied Physics;* **58**: No. 1, 327-331(1 Jul 1985).

Laser chemical vapor deposition (LCVD) is a modification of conventional CVD using a laser heat source. Although the reactant systems used may be similar to conventional CVD, the film growth characteristics may differ in several ways. The changes in the optical properties of the film/substrate during deposition must be considered as the amount of laser energy absorbed determines the surface temperature and the maximum deposition rate. Also affecting the deposition rate is the diffusion of reactants to the reaction zone. Because of the small area heated in LCVD, higher surface temperatures can be accessed before diffusion and convection limit the deposition rate. For favorable reactant systems, very rapid deposition rates (greater than 100 μm/sec) and scan speeds for line deposition (greater than 10 cm/sec) can be achieved.

31496 Ultrahigh vacuum reaction chamber/transfer mechanism attached to an Auger electron spectrometer for the study of the reactions of clean lithium surfaces. Nebesny, K.W.; Armstrong, N.R. (Department of Chemistry, University of Arizona, Tucson, Arizona 84721). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **3**: No. 4, 1763-1767(Jul 1985).

An ultrahigh vacuum reaction chamber/transfer system is described which is used for the production of clean lithium and other soft group I metals. The system is used to study the reactions of clean lithium surfaces with small molecules of interest in electrochemical applications. Auger electron spectroscopy, in a spectrometer coupled to this chamber, shows that the product of the reaction of SO_2 with the clean Li surface is a combination of Li_2S and Li_2O in a 1 : 2 ratio. The transfer system/reaction chamber also allows for the study of the rates of reaction of small molecules with the clean surface. Mechanical scraping of the metal transforms the passive surface into the active, clean state. Study of the SO_2/Li reactions at a variety of temperatures (made possible by the special temperature control in the reaction chamber) shows a low activation energy for the dissociation reaction (2—5 kcal/mol).

31497 Phonon dispersion curves of nonstoichiometric Nb_3Ge. Smith, H.G.; Wakabayashi, N.; Chang, Y.K.; Pintschovius, L.; Weber, W. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Physical Review [Section] B: Condensed Matter;* **31**: No. 12, 7772-7778(15 Jun 1985).

The phonon dispersion curves of nonstoichiometric Nb_3Ge (T/sub c/ = 6 K) have been investigated by inelastic neutron scattering. Despite the small size of the sample (0.1 cm^3) most of the branches along the main symmetry directions, including the highest-energy modes, have been determined. No drastic anomalies were observed and temperature effects were found to be small. The results can be well described by a Born—von Karman model with axially symmetric forces up to the seventh-nearest neighbors. In a search for electron-phonon coupling effects our results for Nb_3(Ge/sub 0.8/Nb/sub 0.2/) are compared to previous results obtained on the low-T/sub c/ compound Nb/sub c/Sb (T/sub c/≃0.2 K). The major differences between the lattice dynamics of the two compounds were found to be (i) a reduction of the Nb-Ge interaction by 35% compared to the Nb-Sb interaction and (ii) the low frequency of modes in Nb_3(Ge/sub 0.8/Nb/sub 0.2/) which involve a "buckling" of the Nb chains.

31498 Magnetic and Moessbauer studies on rare-earth-containing Heusler alloys Pd_2RSn (R = Tb—Yb). Malik, S.K.; Umarji, A.M.; Shenoy, G.K. (Materials Science and Technology Division, Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review [Section] B: Condensed Matter;* **31**: No. 11, 6971-6975(1 Jun 1985).

Magnetic susceptibility and ^{119}Sn Moessbauer studies have been carried out on a new series of rare-earth-containing Heusler alloys having the formula Pd_2RSn (R = Tb—Yb). The Tm and Yb compounds in this series along with Lu, Sc, and Y compounds are superconducting. The magnetic susceptibility of Pd_2TmSn and Pd_2YbSn deviates from the Curie-Weiss behavior at low temperatures indicating that crystalline electric field effects are appreciable. Analysis of the magnetic susceptibility data in terms of crystalline electric fields shows that the ground state of the Tm^{3+} ion is nonmagnetic which, therefore, does not affect the superconducting state. The susceptibility of Yb^{3+} ions at low temperatures is also reduced from the free-ion value due to the crystalline electric field interaction. The Tb- and Dy-containing compounds order antiferromagnetically with Neel temperatures of 9 and 15 K, respectively, while Er- and Ho-containing compounds are paramagnetic down to 1.4 K. The hyperfine field at the Sn site in Pd_2TbSn is about 50 kOe but is only about 10 kOe in Pd_2DySn at 4.2 K.

31499 Localization effects on superconductivity in homogeneous metallic glasses. Poon, S.J. (Ames LaboratoryU.S. Department of Energy, Iowa State University, Ames, Iowa 50011). *Physical Review [Section] B: Condensed Matter;* **31**: No. 11, 7442-7445(1 Jun 1985).

It is pointed out that localization effects on bulk superconductivity do exist and can be significant in homogeneous amorphous alloys (or typical metallic glasses) whose upper critical fields appear to follow the standard Werthamer-Helfand-Hohenberg-Maki (WHHM) curves. Owing to the similarity in the temperature dependence of critical fields predicted by the Fukuyama-Ebisawa-Maekawa theory of the weakly localized regime and the WHHM results over a very wide temperature range, these effects have escaped notice heretofore. Comparison of the electronic density of states obtained from specific-heat measurement (absence of field-induced delocalization effects) and the "apparent" one derived from fitting critical-field data reveals the aforementioned effects.

31500 (UCRL-Trans—12061) Nonlinear propagation of elastoplastic waves in Ke penetrators. (Excerpts). Kuscher, G.F. (Lawrence Livermore National Lab., CA (USA); Ernst Mach Inst., Freiburg (Germany, F.R.)). May 1985. Contract W-7405-ENG-48. Translated from Report 2/85. 143p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE85011450.

The characteristic principles of the approximation models are discussed briefly. As a result of the present study, it has been possible for the first time to obtain experimental confirmation of the basic hypotheses of the theory of elastic as well as elastoplastic wave propagation and to obtain dynamic material data corresponding to the theoretical definitions. The one-dimensional elastic and elastoplastic theory of wave propagation is discussed in detail. In general, all authors assume a one-dimensional treatment of wave propagation as the basis for an experimental study of elastoplastic properties of materials in bars. Within the present study, no experimental findings were obtained, such as boundary influences or dispersion of the elastic wave, which would not justify this type of analysis.

31501 Influence of adsorbed Bi on the chemisorption properties of Pt(111):H_2, CO, and O_2. Paffett, M.T.; Campbell, C.T.; Taylor, T.N. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **3**: No. 3, 812-816(May 1985).

The growth modes and interactions of vapor-deposited Bi on a clean Pt(111) surface and its effects on the chemisorption of H_2, CO, and O_2 have been monitored by Auger electron spectroscopy (AES), low-energy electron diffraction (LEED), and thermal desorption mass spectroscopy (TDMS). For submonolayer Bi coverages, LEED patterns were observed to progress with increasing coverage through p(2 x 2), (7/8 x 7/8)R30°, p(3 x 3), and p(4 x 4) structures. The Bi TDMS and AES data are consistent with proposed structural models giving absolute coverages of 0.25, 0.33, 0.44, and 0.56, respectively. For submonolayer coverages of this s^2p/sup n/-type metal, Bi adatoms are strongly repulsive and maximize their spacing subject to the constraints of the Pt(111) sites. This is to be contrasted with d/sup n/s/sup m/-type metals such as Ag, Cu, and Au on Pt(111), which show attractive interactions and coalesce into 2d islands. In chemisorption of small molecules on Pt(111), each Bi adatom blocks about two Pt surface atoms. An ensemble of two adjacent Pt sites is required for both dissociative H_2 and molecular O_2 adsorption versus one site for CO adsorption; therefore, uptake of the former adsorbates is much more severely attenuated as θ/sub Bi/ increases.

31502 Oxidation of $Ni_{60}Fe_{40}$(100) in the presence of sulfur. Lad, R.J.; Schrott, A.G.; Blakely, J.M. (Materials Science and Engineering, Cornell University, Ithaca, New York 14853). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **3**: No. 3, 1282-1286(May 1985). Contract AC02-79ER10501.

The effect of adsorbed sulfur on the initial oxidation of a $Ni_{60}Fe_{40}$(100) alloy surface has been studied at 100 and 500 °C using low energy electron diffraction (LEED) and Auger electron spectroscopy (AES). Measurements of the oxygen uptake rate have been made as a function of sulfur coverage at each temperature. Within the O_2 exposure range studied, the uptake of O_2 is observed to be inhibited by an ordered c(2 x 2) sulfur phase at 0.5 monolayers coverage, independent of temperature. For sulfur coverages below 0.5 monolayers, an Fe-rich surface oxide forms with a composition and morphology dependent on the sample temperature. The experimental observations suggest that at 500 °C, sulfur-free oxide islands grow interspersed between c(2 x 2)S domains whereas at 100 °C, the adsorbed sulfur layer becomes overgrown by coalesced oxide. The mechanisms of oxide nucleation and growth are related to the existence of different phases of the chemisorbed sulfur + oxygen layer as previously studied.

31503 Field adsorption of inert gas atoms on the tungsten surface: A pulsed-laser atom-probe study. Kinkus, T.J.; Tsong, T.T. (Physics Department, Pennsylvania State University, University Park, Pennsylvania 16802). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **3**: No. 3, 1521-1524(May 1985).

On a solid surface, inert gas atoms can be field adsorbed to the surface under the influence of a strong electric field. The probability of field adsorption was measured as a function of temperature for He, Ne, and Ar on the W(112) surface. Although it was assumed that gas atoms field adsorb only on top of surface atoms, experimental evidence indicates that secondary sites also exist, such as on bridge sites, between surface atoms, or second layer adsorption sites. A simplified calculation of the binding energy assumes an isolated dipole pair model and significantly overestimates the binding energy at 0.20, 0.19, and 0.24 eV for He, Ne, and Ar at a field of 4.5, 3.9, and 2.5 V/A, respectively. The measured values were 0.17, 0.14, and 0.12 eV. Including a correction for the depolarizing field caused by the layer of polarized adatoms gives a reasonable agreement with the experimental values at 0.18, 0.16, and 0.13 eV.

31504 Ellipsometric investigation of Be(0001) oxidation. Christensen, T.M.; Blakely, J.M. (Materials Science and Engineering, Cornell University, Ithaca, New York 14853). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **3**: No. 3, 1607-1612(May 1985). Contract AC02-79ER10501.

Studies by ellipsometry of the early stages of oxidation of the Be(0001) surface in the temperature range 30—600 °C have been made in conjunction with Auger electron spectroscopy (AES) and low energy electron diffraction (LEED). An initial decrease in the ellipsometric parameter Psi is taken to indicate incorporation of oxygen into the beryllium surface. The magnitude of the decrease in Psi depends on temperature and is greatest around 100 °C. It is proposed that at the minimum in Psi the surface consists of islands of BeO in an electron depleted Be layer; an effective medium approximation, assuming nearly free electron behavior for Be, can describe the experimental results with reasonable values of the parameters. After oxide coalescence, p(2 x 2)-BeO and ((3)/sup 1/2/x(3)/sup 1/2/)R30° -BeO LEED patterns are observed. They are unstable under an electron beam, but can be regenerated by short anneals at 500 °C. The ellipsometric parameter Δ is observed to be significantly different for the surface with and without this ordered structure. This change in Δ is not directly related to changes in the degree of order, but may be caused by electron beam enhanced decomposition of adsorbed gas. Ellipsometry results for oxygen on Ni(111) have also been obtained; these assist in the interpretation of the Be data.

31505 Initial oxidation of Zn(0001) surfaces: H_2 adsorption and XPS studies. Chan, L.; Griffin, G.L. (Department of Chemical Engineering and Materials Science, University of Minnesota, Minneapolis, Minnesota 55455). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **3**: No. 3, 1613-1617(May 1985). Contract AC02-79ER10450.

H_2 adsorption capacity measurements have been combined with XPS intensity measurements to study the kinetics of O_2 uptake on Zn(0001) surfaces. On clean Zn(0001) the temperature programmed desorption spectrum of H_2 shows half-order desorption kinetics and an apparent desorption energy of 11 kcal/mole. As the surface is oxidized by progressive dosing with O_2, two features are noted: The H_2 desorption spectrum characteristic of clean Zn(0001) is attenuated in a nonlinear fashion and a new H_2 desorption state with an activation energy of 18 kcal/mole is observed for surfaces with less than saturation oxygen coverage. XPS results indicate that H_2 adsorption is not completely blocked until an oxygen coverage corresponding to approximately 3 monolayers is achieved. Both H_2 uptake and XPS intensity measurements also indicate that the oxygen sticking coefficient increases with oxygen coverage up to about one half of the O_2 saturation coverage. These results indicate that the initial oxidation of Zn surfaces involves the formation and growth of multilayer oxide islands, where oxygen incorporation at the perimeter of the islands is the rate limiting step.

31506 Creation of tailored surfaces using selective oxidation of ion-implanted materials. Brown, D.W.; Musket, R.G.; Weirick, L.J. (Department of Applied Science, University of California Davis/Livermore and Lawrence Livermore National Laboratory, Livermore, California 94550). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **3**: No. 3, 583-587(May 1985). Contract W-7405-ENG-48.

Ion implantation can produce a subsurface layer composition very different from that of the bulk material. The present work involves postimplant selective-oxidation treatments to produce a tailored surface composition. Formation of Al_2O_3-rich layers on both pure iron and 304-L stainless steel was achieved by implanting aluminum and subsequently heating the implanted sample in a controlled oxidizing environment to allow the subsurface aluminum to diffuse to the surface and oxidize. The thickness and composition of the resulting oxide layer was found to be strongly dependent on (a) the oxide layer existing prior to the selective oxidation, (b) the parameters of the treatment (i.e., composition and pressure of the furnace gases and time), and (c) the dose of aluminum implanted. Compositional analyses via ion backscattering and Auger electron sputter profiling were performed to study the processes and mechanisms.

31507 Pulsed x-ray induced damage to metal and multilayer mirrors. Kohler, D.; Guttman, J.L.; Watson, B.A.; Gerassimenko, M. (Applied Physics Laboratory, Lockheed Palo Alto Research Laboratory, Palo Alto, California 94304). *Review of Scientific Instruments;* **56**: No. 5, 812-814(May 1985).

The effects of intense pulses of laser-produced x rays upon the reflective and diffractive properties of metal mirrors and layered synthetic microstructure mirrors (artificial crystals) have been investigated. Laser pulses from a Nd—glass pulsed laser system of 25-ns pulse width and 50-J energy were focused onto a copper target to generate x-ray pulses. A polished planar nickel mirror reflected 0.98- to 1.3-keV x rays onto photographic film. The x-ray flux onto the mirror (at grazing incidence angles near 3.5°) was split into two adjacent fields with a beryllium filter over one field and with an equal thickness beryllium filter placed over the film holder covering the adjacent field. Thin pieces of Kimfol were used as debris shields ahead of the mirror sample. This technique provided an in situ normalization since both a low- and high-intensity irradiation can be simultaneously achieved on adjacent portions of the mirror. A similar technique was used to study reflection by a multilayer mirror of carbon—tungsten carbide layering with a 2d spacing of 3.92 nm. Experimental details and the results obtained are presented.

31508 (RFP-Trans—438) Refractory material which is resistant to oxidation and hot corrosion at temperatures of 1000-1600°C. Schlichting, J. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant; Bundesministerium der Verteidigung, Bonn (Germany, F.R.)). May 1985. Contract AC04-76DP03533. Translation of BMVg-FBWT-79-32. 50p. NTIS (US Sales Only), PC A03. File Number DE85011580.

The report summarized results on development and applicability of a refractory metallic material which is resistant against oxidation in air and against hot corrosion in burnergas with additions of NaCl, V_2O_5 and H_2S up to temperatures between 1000 and 1500°C. This material consists of niobium, tantalum or their alloys, coated with a sintered 200 to 300 μ protective layer of $MoSi_2$. It is also shown by test results that this material can be considered for application as turbine blades. In preliminary test with centrifugal acceleration of 100,000 g at 1200°C no measurable damage of this material has been observed.

31509 Suppression of spin fluctuations by alloying in UPt_3. Stewart, G.R.; Giorgi, A.L. (Materials Science and Technology Division, Los Alamos National Laboratory, Los Alamos, New Mexico). *Journal of Low Temperature Physics;* **59**: No. 1, 185-189(1 Apr 1985).

In order to investigate the normal state spin fluctuation behavior of UPt_3, we have measured the low temperature resistivity and specific heat C of U(Pt/sub 0.8/Pd/sub 0.2/)$_3$, which we find to be close to the phase stability boundary for the hexagonal UPt_3 structure. The evidence for spin fluctuations observed in UPt_3,aT^3 ln (T/T/sub SF/) upturn in C/T below 10 K, is totally suppressed in U(Pt/sub 0.8/Pd/sub 0.2/)$_3$, and the γ value, proportional to the dressed density of states, is decreased by 50% compared to pure UPt_3. This extreme sensitivity to substitution by isoelectronic Pd for Pt indicates that the spin fluctuations in UPt_3 depend critically on the hybridization of the U electrons, U-U separation equal to 4.2 A, with the electrons of the intervening atoms.

31510 Comparison between Ti anomalous x-ray scattering factors obtained from layered synthetic microstructures and the dispersion relationship. Warburton, W.K.; Ludwig K.F. Jr.; Barbee T.W. Jr. (Stanford Synchrotron Radiation Laboratory, Stanford University, Stanford, California 94305). *Journal of the Optical Society of America B: Optical Physics;* **2**: No. 4, 565-567(Apr 1985).

We compare Ti anomalous x-ray scattering factors f' obtained close to the Ti K absorption edge by two techniques: analysis of changes in Bragg peak reflectivity and resolution for scattering from a Ti/C layered synthetic microstructure (LSM) and integration through the Kramers—Kronig dispersion relationship of absorption data on pure Ti. The agreement is good for initial results and suggests that the LSM technique should be developed further as a technique for obtaining medium-accuracy x-ray optical constants across large energy ranges.

31511 Heavy-fermion uranium systems. Fisk, Z.; Ott, H.R.; Smith, J.L. (Los Alamos National Lab., NM (USA)). *Journal of Magnetism and Magnetic Materials;* **47/48**: 12-16(Feb 1985).

We review the experimental results on heavy-fermion uranium based superconductors and magnets.

31512 Electrical resistivity of $ThRu_2$. Lawson, A.C. (Pomona Coll., Claremont, CA (USA). Dept. of Physics and Astronomy; Los Alamos National Lab., NM (USA). Materials Science and Technology Div.). *Physics Letters [Section] A;* **107**: No. 1, 45-47(7 Jan 1985).

A simple procedure is given for fitting experimental electrical resistivity data to the parallel resistor model. The procedure is applied to the C-15 compound $ThRu_2$.

31513 Electron beam and pulsed laser irradiation of glass-forming Cr-Ta and Cr-Zr-Ge alloys. Alden, D.A.; Massalski, T.B.; Lowndes, D.H. (Carnegie-Mellon Univ., Pittsburgh, PA). *Scripta Metallurgica;* **19**: 67-72(Jan 1985).

Preliminary results are reported on the application of (1) an electron beam, (2) a pulsed laser whose pulse duration is of the order of about 0.5 msec, and (3) a pulsed laser of about 35 nsec pulse duration, to the surface of one binary Cr-Ta and three ternary Cr-Zr-Ge alloys. In order to enhance the possibility of producing a metallic glass through these irradiations, each of the alloys was prepared in a eutectic or near-eutectic region of the respective phase diagram. Irradiation produced homogenization and grain refinement in the Cr-Ta alloy surface, but no amorphous phase was detected. The ternary alloys, however, produced both metallic glass and a fine-grained FCC structure. 6 references.

31514 **Pulsed electron beam annealing of A15 tape superconductors.** Braginski, A.I.; Greggi, J.; Janocko, M.A. (Westinghouse Research and Development Center, Pittsburgh, PA (USA)); Kleiser, T.; Meyer, O. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Nukleare Festkoerperphysik). *Nuclear Instruments and Methods in Physics Research, Section B: Beam Interactions with Materials and Atoms;* **233**: No. 3, 525-533(Dec 1984).

Thick films of Nb_3Ge and Nb_3Sn on niobium and Hastelloy B tape substrates were e-beam annealed using single 300 ns pulses and deposited energy densities, Esub(p), between 0.5 and 5 J/cm^2. In most cases the energy density thresholds causing melting, Esub(pt), agreed reasonably with numerical simulation data. The melted and resolidified layers were microcrystalline A15's when Esub(p)/Esub(pt)>1.1, and coarse-crystalline A15 at Esub(p)/Esub(pt)>=1.4. Melting and resolidification resulted in film crazing/cracking due to the differential thermal contraction. The extent of film damage depended upon the film-substrate mismatch. The critical current density, jsub(c), was accordingly reduced. In the absence of crazing/cracking at Esub(p)/Esub(pt)>=1 an indication of jsub(c) increase in Nb_3Sn was obtained. This increase was attributed to the formation of additional flux pinning centers such as grain boundaries and/or second-phase precipitates.

31515 **Revision of the uranium-iron phase diagram.** Chapman, L.R.; Holcombe, C.E. Jr. (Union Carbide Corp., Oak Ridge, TN (USA). Nuclear Div.). *Journal of Nuclear Materials;* **126**: No. 3, 323-326(Nov 1984).

31516 **Surface tension of sodium.** Goldman, J.H. (Argonne National Lab., IL (USA). Chemical Technology Div.). *Journal of Nuclear Materials;* **126**: No. 1, 86-88(Sep 1984).

31517 **Effect of extrusion texture on the linear thermal contraction and mechanical properties of the uranium-2.4 wt% niobium alloy.** Kollie, T.G.; Anderson, R.C.; Carpenter, D.A.; Smith, D.D. (Oak Ridge Y-12 Plant, TN (USA)). *Journal of Nuclear Materials;* **125**: No. 2, 160-169(Jul 1984).

The effects of forward extrusion in the α-phase on the linear thermal contraction (LTC) and tensile mechanical properties of the uranium-2.4 wt% niobium (U-2.4Nb) alloy were studied. Extrusion parameters investigated included: extrusion ratio, extrusion ram speed, extrusion die angle, and billet preheat temperature. The investigation revealed that the anisotropic LTC developed in the alloy could be correlated with the preferential alignment of the crystallographic axes of the alloy caused by extrusion. The LTC and tensile strengths decreased with an increase in the extrusion ratio. The effects of the other extrusion parameters on the properties were small.

31518 **Ion beam mixing of metal films on SiO_2.** White, C.W.; Farlow, G.; Narayan, J. (Oak Ridge National Lab., TN (USA)); Clark, G.J.; Baglin, J.E.E. (IBM Research Laboratories, Yorktown Heights, NY (USA)). *Materials Letters;* **2**: No. 5, 367-372(Jun 1984).

Ion beam mixing of certain metals deposited on SiO_2 substrates causes reactions to occur which result in the formation of metal-rich silicides in the region of the interface and an increase in the adhesion of the film to the substrate. For other metals, ion irradiation causes lateral transport and coalescence of metal atoms resulting in the formation of an island structure. The results obtained by ion irradiation are compared with previous studies of high-temperature thermal processing of metal films on SiO_2.

31519 **Local atomic order of a Ni-12.7 at.% Al alloy quenched from 1323 K.** Epperson, J.E.; Fuernrohr, P. (Max-Planck-Institut fuer Metallforschung, Stuttgart, West Germany). *Acta Crystallographica, Section A: Foundations of Crystallography;* **A39**: 740-746(1983).

High-angle x-ray diffuse scattering was measured in a volume element in reciprocal space for a Ni-12.7 at.% Al alloy single crystal quenched from 1323 K. The Cowley-Warren order parameters were determined after separation of the first- and second-order size effects, using a procedure based on the Borie-Sparks quadratic approximation of atomic displacements. The experimental order coefficients were used to reconstruct the real-space locally ordered distribution of atoms, from which the spectrum of nearest-neighbor atomic configurations was determined. Some 61% of the Al atoms were found to be in a planar-ordered configuration consisting of a nickel atom and four nearest-neighbor aluminum atoms, the basic structural unit of Ni_3Al. These planar elementary ordered units were, of course, distributed on the three equivalent {100} planes. While most of the ordered domains consisted of from one to three Ni_3Al rings, a few domains were found to contain on the order of 100 such elementary ordered units. The larger ordered domains may be thought of as embryos of the ordered Ni_3Al phase that formed during quenching of the bulk-alloy single crystal. There is evidence that the spatial distribution of ordered domains is not random. 24 references, 3 figures, 4 tables.

31520 **Ordered steps on Bi(~ 0001) vicinal surfaces by laser pulse anneal.** Ellis, W.P.; Thompson, K.A.; Nogar, N.S. (Los Alamos National Lab., NM). *Surface Science;* **130**: 317-323(1983).

LEED patterns characteristic of an ordered array of equally spaced steps of minimum height resulted from pulsing disordered Bi(~ 0001) vicinal surfaces. Ten XeCl eximer laser pulses at λ = 308 nm, of 10 ns duration and 4 mJ/cm^2 each and at 0.5 s intervals optimized ordering on the Bi(10116) surface, but additional exposure degraded the surface crystallinity as did a twentyfold increase in power density.

31521 **AES studies of palladium films formed on copper and mica.** De Cooman, B.C.; Vankar, V.D.; Vook, R.W. (Syracuse Univ., NY). *Surface Science;* **128**: 128-144(1983). Contract AC02-77ER04496.

Thin epitaxial films of palladium were grown on epitaxial copper films and cleaved mica in ultra high vacuum. The growth modes of these films were investigated by Auger electron spectroscopy (AES), low energy electron diffraction (LEED), transmission electron microscopy (TEM), and TEM replica techniques. Layer by layer growth of Pd on Cu and mica was observed and inelastic mean free paths of Auger electrons for energies of 60 eV (Cu MMM) and 329 eV (Pd MNN) were calculated. These values were 5.7 and 6.9 A respectively. The thermal stability of monocrystalline and polycrystalline Pd/Cu bilayer films at 483 K was also investigated by AES and TEM. It was found that Pd agglomerates on the Cu at this temperature to form a Stranski-Krastanov growth morphology. The agglomeration is much more rapid on polycrystalline films, suggesting that high surface diffusivity paths (grain boundaries and possibly other defects) enhance the surface diffusion of Pd on Cu. 14 references, 14 figures.

31522 **Pb/sub 0.77/K/sub 0.23/[Pt(CN)$_4$].1.5H$_2$O: a new type of partially oxidized tetracyanoplatinate salt.** Coles, G.S.V.; Underhill, A.E.; Williams, J.M.; Schultz, A.J. (University Coll. of North Wales, Bangor). *Journal of the Chemical Society, Dalton Transactions: Inorganic Chemistry;* 2529-2530(1983).

The preparation and properties of a new type of partially oxidized tetracyanoplatinate salt, Pb/sub 0.77/K/sub 0.23/[Pt(CN)$_4$].1.5H$_2$O, are reported. The electrical conduction properties are compared with those of previously known one-dimensional metallic complexes of platinum. 7 references, 2 figures.

3602 Ceramics, Cermets, And Refractories

REFER ALSO TO CITATION(S) 31074, 31075, 31076, 31077, 31080, 31080, 31389, 31390, 31391, 31392, 31397, 31404, 31405, 31407, 31408, 31409, 31410, 31411, 31507, 31666, 32487

31523 (AD-A—150167/5/XAB) Electrical and thermal transport property studies of high-temperature thermoelectric materials. Interim report, 15 August 1983-15 May 1984. Bates, J.L.; Garnier, J.E.; Olsen, L.C.; Griffin, C.W. (Pacific Northwest Labs., Richland, WA (USA)). Jul 1984. 105p. NTIS, PC A06/MF A01.

The first year of this research emphasized the study of electronically conducting oxides with varied transport characteristics, an evaluation of theoretical models, and the determination of a high-temperature transport property data base. Oxide systems based on SnO_2-In_2O_3, (La, Y) (Mg,Ca,Sr) CrO_3, HfO_2-RxOy-In_2O_3 and La(Sr)MnO_3 were selected for initial studies and represent different crystallographic/defect structures and transport characteristics. The electrical conductivity, Seebeck coefficient and thermal conductivity for these oxides are being measured and have provided a preliminary data base for evaluating transport properties and the figure of merit. This report describes the technical results obtained during the first year's study of high-temperature thermoelectric materials. The scope of the research is (a) to develop theoretical models for electrical, thermal, and thermoelectric behavior of refactory oxide materials, (b) to determine electrical transport properties necessary to develop and test these models, (c) to determine methods for increasing the figure of merit in refractory oxide systems by varying compositon, defect structure. microstructure, etc., and (d) to use these models to establish theoretical and empirical limits of the figure of merit for these oxides and other refractory materials.

31524 (AD-A—151413/2/XAB) Transformation-toughened ceramics. A potential material for light diesel engine applications. Final report, 1 October 1982-30 September 1983. Tien, T.Y. (Michigan Univ., Ann Arbor (USA). Dept. of Materials and Metallurgical Engineering). Jun 1984. 54p. NTIS, PC A04/MF A01.

This report contains three parts: thermal-conductivity studies in the system Al_2O_3- Cr_2O_3-ZrO_2-HfO_2 are presented in the first part; mechanical behavior of these compositions is presented in the second part; and the mullite - ZrO_2 system are discussed in the third part. The results indicate that a composition containing 15 mole % of Cr_2O_3 in Al_2O_3 in the matrix phase has a thermal conductivity comparable to that of stabilized zirconia.

31525 (CONF-8505138—2) Magnitude and range of the RKKY interaction in $SmRhB_4$. Terris, B.D.; Gray, K.E.; Dunlap, B.D. (Argonne National Lab., IL (USA)). Apr 1985. Contract W-31-109-ENG-38. 10p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85012284.

From Materials and mechanisms of superconductivity conference; Ames, IA, USA (29 May 1985).

The superconductive and magnetic transition temperatures taken together are shown to provide a unique probe which separately determines both the magnitude and range of the RKKY interaction in the $RERh_4B_4$ magnetic-superconductors (RE = Er, Sm). Experimentally, an unexpected peak is found in the antiferromagnetic ordering temperature of $SmRh_4B_4$ vs. electron mean free path, while for $ErRh_4B_4$ the ferromagnetic ordering temperature decreases monotonically. These qualitative features, as well as the quantitative differences between $SmRh_4B_4$ and $ErRh_4B_4$, are in excellent agreement with calculations using a mean free path dependent RKKY interaction.

31526 (CONF-8505138—3) Formation, ion modification, and annealing of VN. Thompson, J.R.; Ellis, J.T.; Christen, D.K.; Lewis, J.D.; Sekula, S.T. (Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville (USA). Dept. of Physics). Apr 1985. Contract AC05-84OR21400. 18p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85012896.

From Materials and mechanisms of superconductivity conference; Ames, IA, USA (29 May 1985).

Thin films of vanadium nitride, formed by diffusion of N_2 gas into previously characterized vanadium films, have been modified using ion beam techniques. Irradiation by N-ions produced decreases in the superconductive transition temperature T/sub c/ and electrical resistance ratio RRR, which saturated at 3.6 K and 1.0, respectively. It was found that films with higher T/sub c/ values were less susceptible to ion-damage. An isochronal annealing study revealed several annealing stages and nearly complete recovery of T/sub c/. Laser annealing of this brittle material was rather ineffective, however. The results of this work are related to the possible formation of high T/sub c/, B1 phase MoN. 16 refs., 3 figs.

31527 (DOE/ER/45016—1) Electron optical and microanalytical studies of precipitation in ceramic systems. Progress report, July 1, 1983-June 30, 1984. Notis, M.R. (Lehigh Univ., Bethlehem, PA (USA)). May 1985. Contract AC02-83ER45016. 16p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85012541.

Research work has been performed in four major areas: Laser Raman Spectroscopy and x-ray diffraction studies of pure and impurity stabilized zirconia powders, Laser Raman Spectroscopy and x-ray diffraction studies of pure yttria and lanthana doped yttria powders, preparation of tetragonal impurity doped ternary MgO-TiO-ZrO_2 powders by coprecipitation gel techniques, and transmission electron microscope study of defect (twin) structure in CaZrOp. NTIS, PC A05/MF A01; GPO Dep. File Number DE85012391.

Thesis.

Chlorination of $CaSi_2$ produces a chlorosilane mixture containing Si_2Cl_6 and Si_3Cl_8. These compounds may be separated by simple distillation. A reflux reactor system was developed in this work which has several advantages over the liquid ammonia process. The liquid ammonia layer in the Ube process is advocated as a means of removing NH_4Cl from the reaction product. However, material made in the reflux reactor, and subsequently washed with liquid ammonia, has the same chlorine content (100 ppM) after pyrolysis as the powder produced by Ube. There are potential advantages in using Si_2Cl_6 and Si_3Cl_8. The measured ceramic yields of $Si_2(NH)_3$ (88%) and $Si_3(NH)_4$ (94.6%) are higher than that of $Si(NH)_2$ (83%). Although none of the silicon imide compacts densified during pyrolysis at the relatively low temperatures (1200 to 1450°C) which were used, the particles produced are sufficiently small (0.3 μm) that they might sinter at higher temperatures. Carbon may be incorporated into the silicon imide structure by copolymerizing a chlorosilane and a small amount of chloroalkane with ammonia. When such a powder was pyrolyzed, the resulting product was α - Si_3N_4 with no detectable SiC. The carbon in the powder was effective in reducing the oxygen content of the silicon nitride.

31532 (KEK—82-14, pp 179-181) Properties of SiC ceramics and application for microwave absorber. Watanabe, M.; Okuno, A. (NCK Spark Plug Co., Ltd.); Matsumoto, H. Jan 1983. (In Japanese). NTIS (US Sales Only), PC A11/MF A01. File Number DE85781031. (CONF-8208206—Summ.).

From 7. meeting on linear accelerators; Oho, Ibaraki, Japan (24 Aug 1982).

Published in summary form only.

31533 (LA-UR—85-981) Synthesis of ultrafine ceramic and metallic powders in a thermal argon rf plasma. Vogt, G.J.; Vigil, R.S.; Newkirk, L.R.; Trkula, M. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 7p. (CONF-850714—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE85009634.

From Symposium on plasma chemistry; Eindhoven, Netherlands (1 Jul 1985).

Ultrafine powders of SiC, Si_3N_4, Ni, and Al_2O_3 have been prepared in a rf-plasma reactor, utilizing an induction plasma tube designed at Los Alamos. The primary particle size of the ceramic powders ranges from 5 to 50 nm. Silicon carbide and alumina are ultrapure crystalline powders, while silicon nitride is amorphous for surface areas greater than 100 m^2/g. Plasma nickel powder will sinter to full density at 1073 K.

31534 **(LBL—19396) High resolution electron microscopic characterization of interfaces in ceramics.** Sarikaya, M.; Aksay, I.A.; Thomas, G. (Washington Univ., Seattle (USA). Dept. of Materials Science and Engineering; California Univ., Berkeley (USA). Dept. of Materials Science and Mineral Engineering; Lawrence Berkeley Lab., CA (USA)). Aug 1984. Contract AC03-76SF00098. 15p. (CONF-8407123—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85011207.

From Advances in materials characterization II conference; Alfred, NY, USA (29 Jul 1984).

High resolution electron microscopy (HREM) is useful in bringing out the microstructural variations, such as structural details at grain boundaries, at very high resolutions, even at atomic levels. An important aspect is the examination of the surface irregularities at the boundary regions which provide information on the transformation characteristics of the phases. In this paper, we present data on the microstructural characteristics of some high temperature ceramics (silicon nitride, mullite, and aluminum nitride) with particular emphasis on the detection of grain boundary amorphous phases. Furthermore, the HREM technique is reevaluated with reference to other techniques.

31535 **(N—85-15878) Optimization of the NiCrAl-Y/ZrO-Y2O3 thermal barrier system.** Stecura, S. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1985. 24p. (NASA-TM—86905; E—2394; CONF-850536—2). NTIS, PC A02/MF A01.

From American Ceramic Society annual meeting; Cincinnati, OH, USA (5 May 1985).

The effects of bond and thermal barrier coating compositions, thicknesses, and densities on air plasma spray deposited Ni-Cr-Al-Y/ZrO2-Y2O3 life were evaluated in cyclic furnace oxidation tests at temperatures from 1110 to 1220 C. An empirical relation was developed to give life as a function of the above parameters. The thermal barrier system tested which had the longest life consisted of Ni-35.0 wt% Cr-5.9 wt% Al-0.95 wt% Y bond coating and ZrO2-6.1 wt% Y2O3 thermal barrier coating.

31536 **(NRCN(LS)—015) Silicon nitride-fabrication, forming and properties. Literature survey.** Yehezkel, O. (Israel Atomic Energy Commission, Beersheba. Nuclear Research Center-Negev). Jan 1983. 65p. (In Hebrew). NTIS (US Sales Only), PC A04/MF A01. File Number DE85701458.

This article, which is a literature survey of the recent years, includes description of several methods for the formation of silicone nitride, and five methods of forming: Reaction-bonded silicon nitride, sintering, hot pressing, hot isostatic pressing and chemical vapour deposition. Herein are also included data about mechanical and physical properties of silicon nitride and the relationship between the forming method and the properties.

31537 **(PUC-TN—13/83) Study on the influence of annealing effects in GaN VPE.** Furtado, M.; Jacob, G. (Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Fisica). Jun 1983. 33p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85701430.

The effects of annealing that occur during VPE growth of GaN were investigated. GaN powder (and epilayers) samples were annealed in Ar, N_2, H_2, NH_3, HC1 + N_2 and HC1 + H_2(N_2, H_2 and HC1 + N_2), respectively; under a range of experimental conditions of interest for preparing electroluminescent devices. Good surface appearence Zn doped epilayers were also used under N_2 in order to investigate surface morphology changes due to thermal decomposition. It was found that GaN reacts with H_2, remains stable under NH_3, and the effects of thermal decomposition are somewhat enhanced with HC1. The epilayers' behaviour under thermal decomposition and HC1 are interpreted by the greater stability of the (0001) crystal plane, which accounts for the improvement of the surface quality under special growth conditions. Significant observations are reported concerning GaN decomposition in different ambients.

31538 **Electroluminescence in ZnO varistors: Evidence for hole contributions to the breakdown mechanism.** Pike, G.E.; Kurtz, S.R.; Gourley, P.L.; Philipp, H.R.; Levinson, L.M. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of Applied Physics;* **57**: No. 12, 5512-5518(15 Jun 1985).

The previously postulated production of holes during the electrical breakdown of varistors has been directly verified. In some compositions band-gap (3.2 eV) luminescence from the recombination of these holes with free electrons has been observed. The intensity of this luminescence is greater in varistor compositions exhibiting higher nonlinearity coefficients. It is also proportional to the square of the current which implies hole creation by impact ionization in the depletion region near the grain boundaries. This study used varistors of relatively simple chemical composition.

31539 **Investigation of the magnitude and range of the Ruderman-Kittel interaction in $SmRh_4B_4$ and $ErRh_4B_4$.** Terris, B.D.; Gray, K.E.; Dunlap, B.D. (Materials Science and Technology Division, Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review Letters;* **54**: No. 19, 2143-2146(13 May 1985).

The superconductive and magnetic transitioin temperatures taken together are shown to provide a unique probe which separately determines both the magnitude and range of the Ruderman-Kittel interaction in the RRh_4B_4 magnetic superconductors (R = Er, Sm). Experimentally, an unexpected peak is found in the antiferromagnetic-ordering temperature of $SmRn_4B_4$ versus electron mean free path, while for $ErRh_4B_4$ the ferromagnetic-ordering temperature decreases monotonically. These qualitative features, as well as the quantitative differences between $SmRh_4B_4$ and $ErRh_4B_4$, are in excellent agreement with calculations using a mean-free-path—dependent Ruderman-Kittel interaction.

31540 **Self-irradiation effects in ^{238}Pu-substituted zirconolite. Pt. 1. Temperature dependence of damage.** Clinard, F.W. Jr.; Peterson, D.E.; Rohr, D.L. (Los Alamos National Lab., NM (USA). Materials Science and Technology Div.); Hobbs, L.W. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Materials Science and Engineering). *Journal of Nuclear Materials;* **126**: No. 3, 245-254(Nov 1984).

^{238}Pu-substituted cubic zirconolite ($CaPuTi_2O_7$) has stored near ambient temperature, at 575 K, and at 875 K until alpha decay doses as high as 6.1×10^{25} α/m^3 were attained. Self-damage at the lowest temperature proceeded by accumulation of alpha-recoil tracks was partly or wholly suppressed at the higher temperatures. Full conversion to the metamict condition near ambient temperature was accompanied by bulk swelling of 5.4 vol%. Self-damage at 575 K and 875 K was characterized by lesser amounts of swelling (4.3 vol% and 0.4 vol%); however, subsequent reduction of the storage temperature to ambient resulted in further swelling. Details of this swelling response imply structural differences between metamict states formed at 575 K and ambient temperature. Implications for self-irradiation effects in nuclear waste forms under variable temperature conditions are discussed.

31541 **General statistical description of the fracture particulates formed by mechanical impacts of brittle materials.** Mecham, W.J.; Jardine, L.J.; Reedy, G.T.; Steindler, M.J. (Argonne National Lab., IL). *Industrial and Engineering Chemistry Fundamentals;* **22**: No. 4, 384-391(1983).

The solid particulates formed in standard diametral and axial impact tests of small cylindrical specimens of glasses and ceramics were found to have size distributions that plotted as straight lines on log-normal graphical coordinates. Generalized log-normal parameters were defined for these empirical particle-size distributions according to particle masses (or volumes), surface areas, and particle numbers, including geometric mean shape factors for these distributions. These descriptive parameters were found to correlate with impact severity measured as impact kinetic energy per unit volume of the specimen for representative brittle materials, both vitreous and crystalline. These correlations also define impact strength as a property of materials and can be further generalized to model the impact-fracture process for large-scale as well as small-scale impact effects. Applications of the log-normal analysis were made for the characterization of particles adhering to dry surfaces and for the conditions under which particle fusion may occur in mechanical impacts.

31542 **Electronic structure of Si (111) interface between diamond and hexagonal phases.** Huang, M.Z.; Ching, W.Y. (Univ. of Missouri, Kansas City). *Solid State Communications;* **47**: No. 2, 89-92(1983). Contract AC02-79ER10462.

The electronic structure of the Si (111) interface between the diamond and hexagonal wurtzite structure is studied by first-principles linear combination of atomic orbital (LCAO) method. No gap interfacial states or resonances are found; instead, the calculated density of states curve shows an oscillatory redistribution of electron states and a reduction of band gap of about 10%. It is concluded that the electronic structure of this interface can be approximated as the average of that of the bulk diamond and the hexagonal Si.

3603 Composite Materials

REFER ALSO TO CITATION(S) 29712, 30597

31543 **(DOE/ER/10511—T4) Self-consistent approach to the elastic stiffness of short-fiber composites.** Chou, T.W.; Nomura, S.; Taya, M. (Delaware Univ., Newark (USA). Dept. of Mechanical and Aerospace Engineering). 1979. Contract AC01-79ER10511. 6p. NTIS, PC A02. File Number DE85011231.

The self-consistent approach originally proposed by Hill has been adopted to derive the effective elastic stiffness constants of unidirectional short-fiber composites. The short-fibers are modeled as ellipsoidal inclusions uniformly distributed in the matrix and the transverse isotropy of the composite has been taken into account. The method of analysis is valid for multi-component systems and hence, applicable to hybrid composites. Comparisons of this analysis with existing theories are made for binary composites.

31544 **(DOE/ER/10511—T6) Viscoelastic behavior of short-fiber composite materials.** Nomura, S.; Chou, T.W. (Delaware Univ., Newark (USA). Dept. of Mechanical and Aerospace Engineering). [1985]. Contract AC01-79ER10511. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85011233.

This paper examines the viscoelastic behavior of unidirectional short-fiber composites. Each fiber is approximated by an ellipsoidal elastic inclusion embedded in a viscoelastic matrix. The static correspondence principle which relates the viscoelastic problem to the elastic problem is applied to the modified version of the effective elastic moduli of short-fiber composites originally derived by the authors. Numerical examples for various fiber aspect ratios are derived based upon the collocation approximation method as well as the self-consistent model.

31545 **(N—85-17047) Effects of high energy radiation on the mechanical properties of epoxy-graphite fiber reinforced composites.** Fornes, R.E.; Gilbert, R.D.; Memory, J.D. (North Carolina State Univ., Raleigh (USA)). Dec 1984. 58p. (NASA-CR—174314). NTIS, PC A04/MF A01.

The effects of high energy radiation on the mechanical properties and on the molecular and structural properties of graphite fiber reinforced composites were assessed so that the durability of such composites in space applications could be predicted. Investigative techniques including ESR and infrared spectroscopy, ESCA, contact angle measurements, and dynamic and static mechanical testing (3-point bending and interlaminar shear) were employed. The results using these different techniques are individually described, and the implications of the data are discussed. The proposed plan of work for the next fiscal year is outlined.

31546 **(ORNL/TM—9381) Development and characterization of carbon-bonded carbon fiber insulation for radioisotope space power systems.** Wei, G.C.; Robbins, J.M. (Oak Ridge National Lab., TN (USA)). Jun 1985. Contract AC05-84OR21400. 44p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85013365.

The General-Purpose Heat Source (GPHS), an improved radioisotope heat source, employs a unique thermal insulation material, carbon-bonded carbon fiber (CBCF), to protect the fuel capsule and to help achieve the highest possible specific power. The CBCF insulation is made from chopped rayon fiber about 10 μm in diameter and 250 μm long, which is carbonized and bonded with phenolic resin particles. The CBCF shapes, both tubes and plates, are formed in a multiple molding facility by vacuum molding a water slurry of the carbonized chopped-rayon fiber (54 wt %) and phenolic resin (46 wt %). The molded shapes are subsequently dried and cured. Final carbonization of the resin is at 1600°C. Machining to close tolerances (+-0.08 mm) is accomplished by conventional tooling and fixturing. The resulting material is an excellent lightweight insulation with a nominal density of 0.2 Mg/m^3 and a thermal conductivity of 0.24 W(m.K) in vacuum at 2000°C. Several attributes that make CBCF superior to other known high-temperature insulation materials for the GPHS application have been identified. It has the excellent attributes of light weight, low thermal conductivity, chemical compatibility, and high-temperature capabilities. The mechanical strength of CBCF insulation is satisfactory for the GPHS application; it has passed vibration tests simulating launch conditions. The basic fabrication technique was refined to eliminate undesirable large pores and cracks often present in materials fabricated by earlier techniques. Also, processing was scaled up to incease the fabrication rate by a factor of 10. The specific properties of the CBCF were tailored by adjusting material and processing variables to obtain the desired results. We report here how work on CBCF characterization and development conducted at ORNL from 1978 through 1980 has contributed to the GPHS program to meet the requirements of both the Galileo and Ulysees Missions.

31547 **(SKBF-KBS-TR—82-19) Corrosion of steel in concrete.** Preece, C.M. (Swedish Nuclear Fuel Supply Co., Stockholm. Div. KBS). Oct 1982. 40p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85701270.

A comparative study has been made of those properties of Massiv and Standard cements which are considered to determine their ability to protect steel reinforcement from corroding. Saturated Massiv cement has a higher evaporabel water content, but a significantly finer pore structure than has saturated Standard cement. This fine structure resulted in an electrical resistivity ten times higher and chloride diffusivity ten times lower than those of Standard cement. Electrochemical measurements have shown that the passive current density of steel in Massiv mortar is higher than that of steel in Standard mortar, but the higher current should lead to a more rapid decrease in potential to a level at which neither chloride attack of hydrogen evolution will occur. Whereas steel in Standard mortar was found to be highly susceptible to crevice corrosion, no such attack has been observed in Massiv mortar. Moreover, the initiation of chloride induced corrosion and the subsequent rates of corrosion were both lower in Massiv mortar than in Standard mortar. Thus, it may be predicted that Massiv cement would provide greater protection for steel reinforcement in underground structures exposed to chloride containing ground water than would Standard cement.

31548 **(UCRL—91305) Processing and microstructural characterization of B_4C-Al cermets.** Halverson, D.C.; Pyzik, A.J.; Aksay, I.A. (Lawrence Livermore National Lab., CA (USA); Washington Univ., Seattle (USA). Dept. of Materials Science and Engineering). Feb 1985. Contract W-7405-ENG-48. 21p. (CONF-850122—10). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85013195.

From 9. annual conference on composites and advanced ceramic materials and workshop on testing methods for ceramic matrix composites; Cocoa Beach, FL, USA (20 Jan 1985).

Reaction thermodynamics and wetting studies were employed to evaluate boron carbide-aluminum cermets. Wetting phenomenon and interfacial reactions are characterized using "macroscale" and "microscale" techniques. "Macroscale" evaluation involved aluminum sessile drop studies on boron carbide substrates. "Microscale" evaluation involved the fabrication of actual cermet microstructures and their characterization through SEM, x-ray diffraction, metallography, and electron microprobe. Contact-angle measurements and interfacial-reaction products are reported. 14 refs., 5 figs., 2 tabs.

31549 Flexural fatigue of short fiber reinforced high temperature thermoplastics. Yau, S.; Chou, T.W. (Univ. of Delaware, Newark). *SAMPE (Society for the Advancement of Material and Process Engineers) Quarterly;* **16:** No. 3, 18-21(Apr 1985). Contract FG02-84ER45087.

Short fiber reinforced thermoplastics are gaining increasing importance in the development of composite technology. In this investigation, the studies focus on three types of short glass fiber reinforced thermoplastics: (1) polyetherimide (PEI), (2) polyethersulphone (PES), and (3) polyetheretherketone (PEEK). These matrices possess good resistance to aviation fluids and ability to withstand high temperatures up to 600°F. Specimens were evaluated at room temperature and at elevated temperatures under both static and dynamic loads. Fatigue tests reported herein were performed on Krouse sheet bending fatigue machines, operating at 1750 cpm and a constant deflection mode. Fatigue data are presented in traditional S-N plots. 3 references, 5 figures.

3604 Polymers And Plastics

REFER ALSO TO CITATION(S) 29956, 29957, 30549, 30551, 31281, 31549

31550 (CEA-CONF—7534) Aging irradiation of polymers. Dose-rate and test sequence influence. Alba, C.; Carlin, F.; Chenion, J.; Lemaire, F.; Le Meur, M.; Petitjean, M. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete). May 1984. 40p. (In French). (CONF-840516—8; DAS—83). NTIS (US Sales Only), PC A03/MF A01. File Number DE85751314.

From International symposium on aging in tests of safety equipment for nuclear power plants; Paris, France (15 May 1984).

This work brings up results of the irradiation dose-rate influence on mechanical and electrical properties of technical polymer materials evolution. Polymer samples were subjected to $3.3.10^{-2}$ $Gy.s^{-1}$ and $2.8.10^{-1}$ $Gy.s^{-1}$ dose-rate. Heat and radiation simultaneous action is usualy simulated sequentialy. The hardest simulation on the polymer is the sequence of irradiation followed by thermal aging not the reverse. This study was carried out on eight polymer materials among those used in the electrical appliances for P.W.R. nuclear power plants.

31551 (CEA-CONF—7535) Study on the radiation aging of polymers. Armand, X.; Berthet, J.; Gaussens, G.; Le Meur, M.; Petitjean, M. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete). May 1984. 30p. (In French). (CONF-840516—7; DAS—84). NTIS (US Sales Only), PC A03/MF A01. File Number DE85751313.

From International symposium on aging in tests of safety equipment for nuclear power plants; Paris, France (15 May 1984).

Ten representative polymeric materials for nuclear application are studied. The polymers examined are: resins (polyimide R.P., polyamide imide varnish, silicon resin), thermoplastic elastomers (VAMAC, EPDM, PRC et PRI), sulfur polymers (HYPALON, PPS, polysulfone). The test programme simulating a nuclear reactor service life, consist of three steps: i: γ irradiation dose of 18.10^4 Gray at 80°C; ii: accelerated thermal aging during 240 hours at a temperature of 120-140 or 160°C according to the polymer studied; iii: like the step i. Oxygen consumption is studied during the tests. Experiments are carried out at four dose-rate 14, 10^2, 10^3 and 5.10^3 Gray per hour. The $G(\text{-}O^2)$ of ten polymers decrease when dose increase, the smaller the dose-rate the higher the fullness of decrease.

31552 (DOE/CS/40294—1) Development and demonstration of a spiral-wound thin-film composite membrane system for the economical production of oxygen-enriched air, Phase IV. Final report, January 1, 1983-December 31, 1984. Haesloop, D.G.; Swedo, R.J.; Burnett, L.J. (UOP, Inc., San Diego, CA (USA). Fluid Systems Div.; UOP, Inc., Des Plaines, IL (USA)). 15 Jan 1985. Contract AC01-79CS40294. 146p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE85012380.

Literature searches identified poly (vinyl isobutyl ether) as the most promising candidate barrier material for oxygen enrichment membranes. A membrane with an oxygen/nitrogen selectivity of 6.2 and a stability at 60°C was developed. However, this membrane is fragile. Membranes using poly (2-hexyne) and poly (6-methyl-2-heptyne) were also made. (DLC)

31553 (EUR—9226-FR) Improvement of the functional thermal conductivity of foamed polyurethane. Andreani, A.; Silvent, A.; Roux, G.; Balme, A.; Rivero, J.; Fogg, B. (Commission of the European Communities, Luxembourg. Directorate-General for Information, Market and Innovation). 1984. 59p. (In French). Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities.

Due to gas diffusion through the cell walls of rigid polyurethane foams, the K value of these products increases with time from about 18 mW/mK after processing to nearly 29 mW/mK, value used in France for thermal calculation. The aim of this research is to achieve a significant improvement in the functionnal thermal conductivity of foams to 20 mW/mK by inhibition the gas diffusion after reduction of the initial K value and without incurring a serious increase in manufacturing costs. This study was undertaken jointly by the CSTB and the CEA in collaboration with ICI France SA as raw materials producer and research member and SECMER as manufacturer of foaming equipment. The programme was divided into two parts. In a first stage and only with commercial raw materials, the decreasing of the initial thermal conductivity, $lambda_0$, measured 24 hours after processing is studied, as well as the asymptotic value lambdasub(infinite). During this stage the influence of the type and amount of catalyst, surfactant, foaming gas, the amount of air, the polyol type was taken in account. During the second stage a particular interest was given to the polyols modification to increase their diffusion barrier effect on polyurethane. In fact reduction of diffusion kinetics keeps the lambdasub(infinite) value at a lower level. The minimal lambdasub(infinite) got is 19.6 mW/mK.

31554 (NUREG/CR—4147) Effect of environmental stress on Sylgard 170 silicone elastomer. Buckalew, W.H.; Wyant, F.J. (Sandia National Labs., Albuquerque, NM (USA)). May 1985. Contract AC04-76DP00789. 89p. (SAND—85-0209). NTIS, PC A05/MF A01 - GPO. File Number TI85013268.

Dow Corning Sylgard 170 Silicone Elastomer has been investigated to characterize its response to accelerated thermal aging, radiation exposure, and its behavior under applied compressive forces. Sylgard 170 response to accelerated thermal aging suggests the material properties are not particularly age dependent. Radiation exposures, however, produce significant, monotonic changes in both elongation and hardness with increasing absorbed radiation dose. Elastomer response to an applied compressive force was strongly dependent on environment temperature and degree of material confinement. Variations in temperature produced large changes in compressive forces applied to confined samples. Attempts to mitigate force fluctuations by means of pressure relief paths resulted in total loss of the applied compressive force. Thus, seal applications employing this elastomer in Class 1E equipment required to function during or following an accident should consider the potential loss of compressive force from long-term aging and potential LOCA-temperature transient conditions.

31555 (ORNL—6134) Evaluation of polymer films for electrical insulation. McCoy, H.E. Jr. (Oak Ridge National Lab., TN (USA)). Apr 1985. Contract AC05-84OR21400. 96p. NTIS, PC A05/MF A01; GPO Dep. File Number DE85013532.

Polymer films of several kinds were studied for use as electrical insulators. The studies were initiated in support of the development of gas transformers, in which SF_6 gas is used as the dielectric material and polymer films might be used as insulators. The polymers studied were polyethylene terephthalate, polycarbonate, polyethersulfone, polyparabanic acid, and polyimide. Samples were exposed to SF_6 at 0.4 MPa (4 atm) pressure and at 70, 100, 135, and 160°C for times to 23,000 h. Changes in properties during aging were monitored by periodically removing samples and performing visual, tensile, electrical breakdown, density, and microstructural tests. Tests on two lots of polyethylene terephthalate showed that strength increased and ductility decreased with increasing crystallinity. Tests were initiated on polyetherimide and polysulfone as well as some additional lots of the initial five polymers selected for evaluation. Tensile tests at elevated temperatures were used as one method to determine the maximum use temperatures. General creep characteristics as well as specific creep data were determined for six polymers. Differential thermal expansion distorted the polymer in a bonded polymer-metal composite, and a test was developed for evaluating this form of thermal strain fatigue failure. Some heating tests were run on a prototypic gas transformer coil wound of aluminum and two interlayers of polyethylene terephthalate. The largest problems noted in these tests were associated with thermal expansion mismatches between the structural components of the coil.

3606 Other Materials

REFER ALSO TO CITATION(S) 29889, 29922, 29953, 29956, 29957, 29964, 30301, 30303, 30303, 30303, 30311, 30312, 30718, 30742, 30749, 30837, 31398, 31471, 31764, 31784, 32023, 32122

31556 **(AECL—7803) Chemical durability of alkali aluminosilicate glasses.** Tait, J.C.; Mandolesi, D.L. (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment). Sep 1983. 45p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85900974.

The aqueous durabilities of a series of glasses based on the sodium aluminosilicate system (Na_2O-Al_2O_3-SiO_2) have been studied. The effects of molecular substitution of K_2O or CaO for Na_2O, and B_2O_3 for Al_2O_3 have been investigated. The temperature dependence of leaching in the Na_2O-B_2O_3-Al_2O_3-SiO_2 system was studied with glasses containing 2 wt percent simulated UO_2 fuel recycle waste. The results confirm that aluminosilicate glasses are more durable than their borosilicate counterparts. The leaching results are explained in terms of glass structure and bonding, and a general leaching mechanism for aluminosilicate glasses is presented.

31557 **(CBPF-NF—005/83) About counterintuitive orbital mixing and bond populations.** Jorge, F.E.; Giambiagi, M.; Giambiagi, M.S. de. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1983. 17p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85701416.

It is shown that negative bond and orbital populations may be avoided by the introduction of a weight factor in a bond index definition, together with a suitable parameterization. The negative bond populations found for first-row metal complexes need not be ascribed to counterintuitive orbital mixing but rather, essentially, to the equipartition of the charge distribution. Different definitions of the bond population are compared for ferrocene and the effects of some parameterizations are discussed.

31558 **(CBPF-NF—016/83) Electric field gradient and electronic structure of linear-bonded halide compounds.** Ellis, D.E.; Guenzburger, D.J.R.; Jansen, H.B. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1983. 33p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85701419.

The importance of covalent metal-ligand interactions in determining hyperfine fields and energy-level structure of MX_2 linear-bonded halide compounds has been studied, using the self-consistent local density molecular orbital approach. Results for $FeCl_2$, $FeBr_2$ and $EuCl_2$ obtained using the Discrete Variational Method with numerical basis sets are presented. The high spin configuration for the iron compounds, first predicted by Berkowitz, et al., is verified; a successful comparison with gas phase photoelectron spectra is made. Variation of the predicted electric field gradient with bond length R is found to be rapid; the need for an EXAFS measurement of R for the matrix isolated species and experimental determination of the spin of the EFG is seen to be crucial for more accurate determinations of the sub(57) Fe quadrupole moment.

31559 **(DGRST—81-D-0506) Determination of the thermodynamic properties of heavy organic fluids and research of compounds adapted to low temperature Ranking cycles.** Sagnes, P.; Verneau, A.; Massot, R. (Delegation Generale a la Recherche Scientifique et Technique (DGRST), 75 - Paris (France)). 1982. 78p. (In French). (DGRST—81-D-0507). NTIS (US Sales Only), PC A05/MF A01. File Number DE85751348.

In the energy recovery field, it is very important to get an efficiency that is the most possible nearly the theoretical maximum efficiency. This paper presents the development of a theoretical and experimental method, allowing to estimate quickly the interest of chemical compounds with a view to a utilization in low and medium temperature Rankine cycles. The works carried out consist in the following points: development of a method allowing, from some experimental data, to determine the thermodynamic properties (H, S, V) as a function of temperature and pressure; measurement of the specific heat of a fluid in the gaseous phase; study of the thermal behaviour of two fluids in the presence of usuals metals, study of the decomposition; contacts with industrialists. The results obtained show the validity of the proposed method.

31560 **(DP-MS—85-29) Recirculation within a glass mixture subjected to external and resistive heating.** Pepper, D.W. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). [1985]. Contract AC09-76SR00001. 15p. (CONF-850745—8). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85010068.

From 4. international conference on numerical methods in laminar and turbulent flow; Swansea, UK (8 Jul 1985).

Convective motion within a glass mixture undergoing external and resistive (joule) heating is numerically simulated. A time-split finite element technique and a pseudo-pressure formulation are used to solve the two- and three-dimensional primitive equations of motion. The viscosity, thermal diffusivity, and electrical conductivity vary as a function of temperature; the temperature varies from ambient to 1150°C. 15 refs., 4 figs.

31561 **(FRNC-TH—1893) Study of irradiation defects in GaAs.** Loualiche, S. (Institut National des Sciences Appliquees (INSA), 69 - Villeurbanne (France); Lyon-1 Univ., 69 - Villeurbanne (France)). Nov 1982. 173p. (In French). NTIS (US Sales Only), PC A08/MF A01. File Number DE85751319.

Characterization techniques: C(V) differential capacity, DLTS deep level transient spectroscopy, DDLTS double deep level transient spectroscopy and DLOS deep level optical spectroscopy are studied and theoretical and experimental fundamentals are re-examined. In particular the centres created by ionic or electronic bombardment of p-type GaAs. New quantitative theoretical bases for the C(V) method are obtained. Study of the optical properties of traps due to irradiation using DLOS. The nature of irradiation defects are discussed.

31562 (IA—1404, pp 80) **Structural study of HNO_3-graphite intercalation compounds by neutron diffraction.** Shaked, H.; Pinto, H.; Melamud, M.; Aviram, I. Jul 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85780940.

Published in summary form only.
In Research laboratories annual report 1983.

31563 (IA—1404, pp 104-105) **Out-of-plane orientation of N_2 molecules adsorbed on graphite.** Moreh, R.; Shahal, O. Jul 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85780940.

Published in summary form only.
In Research laboratories annual report 1983.

31564 (IA—1404, pp 60-61) **Low temperature deposition of pyrocarbon coatings.** Inspektor, A.; Carmi, U.; Raveh, A.; Avni, R. Jul 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85780940.

Published in summary form only.
In Research laboratories annual report 1983.

31565 (IA—1404, pp 95) **Radioactive tracer study of segregation in grown n-type thermoelectric alloys.** Ilzycer, D.; Dukhan, R.; Levinson, J.; Shiloh, M. Jul 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85780940.

Published in summary form only.

In Research laboratories annual report 1983.

31566 (INIS-BR—251) **Color centers in KCN: ferro-elastic alignment and free optical absorption of phonons.** Grillo, M.L.N. (Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Fisica). 1983. 119p. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. File Number DE85701422.

Some color centers in KCN pure and KCL or KOH doped are studied. The used techniques for detection of these color centers were optical absorption and electron paramagnetic resonance (EPR). To obtain this color centers crystals were always exposed to X-rays. With an optical absorption technique, one color center was analysed after X-ray irradiation followed by a suitable photochemical process. Throught the EPR technique the F center and three other centers produced by radiation damage were observed through several KCN solid phases. As in the orthorhombic and ferroelastic phase (temperatures between 168K and 83K), the crystals of KCN present one multidomain structure responsable for strong light scattering on the optical absorption spectra and EPR spectra that does not present the resolved lines formed above 168K, one system of aligned domains was obtained through mechanical stress built specifically to be capable of reducing the number of distinct domain, and this allowed us to observe of partially resolved EPR lines.

31567 (INIS-BR—253) **Specific heat measurements in KCN:KCL mixed crystals.** Ghivelder, L. (Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Fisica). 1983. 111p. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. File Number DE85701423.

An adiabatic calorimeter to perform specific heat measurements of small samples (approximatelly 150 mg) was built. The measurements were taken from 6 to 120 K, iN KCN:KCL mixed crystals, in order to observe the evolution of the antiferroelectric phase transition - that occurs at 83 K in KCN pure. From the experimental results the values of the phase transition critical temperature are found, for some particular concentrations of the mixture, and it was detected that this phase transition disappears with only 10% of Cl^-. This result is explained in terms of a change of the potential wells in the crystal.

31568 (JAERI-M—83-231) **Effect of hydrogen on reaction of graphite with water vapor.** Imai, Hisashi; Fujii, Kimio; Kurosawa, Takeshi; Nomura, Shinzo. (Japan Atomic Energy Research Inst., Tokyo). Jan 1984. 21p. (In Japanese). NTIS (US Sales Only), PC A02/MF A01. File Number DE85701037.

The effect of hydrogen on the rate of reaction with water vapor was studied for four kinds of graphites including IG-11 which is a candidate material for use in the core of the Experimental High Temperature Gas-cooled Reactor. The experiment was carried out at 800 - 1000sup(o)C in the helium flow which contained 0.65 - 1.0 % water vapor and 0 - 1.5 % hydrogen. The rate of reaction with water vapor decreased by addition of hydrogen and the effect of hydrogen was much larger for highly purified graphite than for contaminated one. Based on the experimental results, the effect of hydrogen in the reactor condition was estimated and it was shown to be negligible small at such impurity level as the coolant of the reactor.

31569 (JINR—R-14-83-855) **Investigation of phase transitions in a superionic conductor using the neutron scattering method.** Belushkin, A.V.; Vonsitski, Ya.; Natkanets, I.; Plakida, N.M.; Shuvalov, L.A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1983. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85701030.

The results of investigations of cesium hydrosulfate $CsHSO_4$ on the IBR-2 pulsed reactor are reported. This is the first experiment on neutron scattering in a superionic conductor with a high conductivity due to proton diffusion. The phase transition in metastable phase near 328 K, phase transitions between 328-404 K and 404-423 K have been found. The inelastic neutron scattering spectra have been measured for temperatures 291 K, 328 K, 404 K, 423 K which correspond to different phases of $CsHSO_4$. Data were analysed, diffusion coefficient for protons was estimated and necessary spectrometer resolution to observe diffusion process in this sample was obtained.

31570 (LBL—19452) **Model of amorphous silicon layer regrowth.** Ling, P.; Washburn, J. (Lawrence Berkeley Lab., CA (USA)). Apr 1985. Contract AC03-76SF00098. 10p. (CONF-850421—9). NTIS, PC A02/MF A01; GPO Dep. File Number DE85012608.

From 2. spring meeting of the Materials Research Society; San Francisco, CA, USA (15 Apr 1985).

A new model which combines heterogenous nucleation and growth process to explain the mechanism of the crystal regrowth of amorphous silicon, in contact with a Si single crystal substrate, is presented. This model explains the effects of substrate orientation and impurity concentration on the kinetics of crystal regrowth. A comparison of experimental results with the predictions of the model is also included. 10 refs., 5 figs.

31571 (LBL—19466) **Formation of amorphous silicon by light ion damage.** Shih, Y.; Washburn, J.; Weber, E.R.; Gronsky, R. (Lawrence Berkeley Lab., CA (USA)). Apr 1985. Contract AC03-76SF00098. 10p. (CONF-850421—8). NTIS, PC A02/MF A01; GPO Dep. File Number DE85012605.

From 2. spring meeting of the Materials Research Society; San Francisco, CA, USA (15 Apr 1985).

A model for formation of amorphous silicon by light ion implantation is proposed. It is suggested that accumulation of point defects and/or complexes is required at the initial stage of the amorphization process. Amorphous zone can only form at the end of incoming light ion tracks when the pre-accumulated concentration of point defects reaches a critical value. Depending on the uniformity of point defect distribution, two possibilities for the second stage of amorphization are suggested for the ion implantation at different temperature. Silicon wafers implanted with Boron ions at various temperatures with below and above the critical amorphization dose have been investigated using cross section specimens in high resolution TEM. The amorphization process has as well been studied by Electron Paramagnetic Resonance of the same samples investigated by TEM, allowing the identification of dangling bonds in amorphous zones and point defect clusters. (113), 1/3(111) extrinsic and other smaller distortion 1/x(111) stacking faults were also found during the amorphization process. Liquid nitrogen temperature and/or high beam current were found to be necessary to amorphizate Silicon by Boron ion implantation.

31572 (N—85-19847) **Material growth and characterization for solid state devices.** Stefanakos, E.K.; Collis, W.J.; Abul-Fadl, A.; Iyer, S. (North Carolina Agricultural and Technical State Univ., Greensboro (USA)). Nov 1984. 22p. (NASA-CR—174410). NTIS, PC A02/MF A01.

Manganese was used as the dopant for p-type InGaAs layers grown on semi-insulating (Fe-doped) and n-type (Sn-doped) InP substrates. Optical, electrical (Hall) and SIMS measurements were used to characterize the layers. Mn-diffusion into the substrate (during the growth of In GaAs) was observed only when Fe-doped substrates were used. Quaternary layers of two compositions corresponding to wavelengths (energy gaps) of approximated 1.52 micrometers were successfully grown at a constant temperature of 640 C and InP was grown in the temperature range of 640 C to 655 C. A study of the effect of pulses on the growth velocity of InP indicated no significant change as long as the average applied current was kept constant. A system for depositing films of Al2O3 by the pyrolysis of aluminum isopropoxide was designed and built. Deposited layers on Si were characterized with an ellipsometer and exhibited indices of refraction between 1.582 and 1.622 for films on the order of 3000 A thick. Undoped and p-type (Mn-doped) InGaAs epitaxial layers were also grown on Fe-doped InP substrates through windows in sputtered SiO2 (3200 A thick) layers.

31573 (NAC-AR—84-01, pp 221-224) **Report of the Van de Graaff Group: solid state and materials research. Stability of palladium silicide.** Comrie, C.M.; Leitner, J.; Egan, J. (Cape Town Univ. (South Africa). Dept. of Physics); Pretorius, R. 1984. NTIS (US Sales Only), PC A14/MF A01. File Number DE85780939.

In Annual report June 1984. [Council for Scientific and Industrial Research, Faure (South Africa). National Accelerator Center].

In the investigation Pd was deposited on to a Si(III) substrate and annealed at 850 degrees Celcius to form PdSi. Following this an additional layer of Pd was evaporated on top of the silicide to produce a Si/PdSi/Pd structure. On subsequent annealing at temperatures as low as 300 degrees Celsius it was found that the free metal reacted with the silicide to produce Pd_2Si. It appeared that the ease of PdSi formation following implantation of Pd_2Si is not because of the PdSi layer between the Si and Pd_2Si but is probably due to structural alteration of the Pd_2Si layer during implantation. Rutherford backscattering was used in this investigation.

31574 (NAC-AR—84-01, pp 226-228) **Report of the Van de Graaff Group: solid state and materials research. The influence of Au on the formation of cobalt and nickel silicides.** Pretorius, R.; Ras, H.A.; Cruywagen, J.C. (Stellenbosch Univ. (South Africa). Dept. of Chemistry). 1984. NTIS (US Sales Only), PC A14/MF A01. File Number DE85780939.

In Annual report June 1984. [Council for Scientific and Industrial Research, Faure (South Africa). National Accelerator Center].

The influence of gold on the formation of cobalt and nickel silicides is dealt with. In the case of cobalt silicide formation it was found that by putting thin layers of gold (14A - 200A) between the cobalt metal (1500A) and the silicon substrate, the normal trends of cobalt silicide formation were greatly altered. The influence of gold was measured by means of Rutherford backscattering.

31575 (NAC-AR—84-01, pp 189-190) **Report of the Van de Graaff Group: atomic physics. The manufacture of hydrocarbon cracked foils.** Coetzer, F.J.; Kotze, T.C.; Van der Westhuizen, P. (Stellenbosch Univ. (South Africa)). 1984. NTIS (US Sales Only), PC A14/MF A01. File Number DE85780939.

Short note.

In Annual report June 1984. [Council for Scientific and Industrial Research, Faure (South Africa). National Accelerator Center].

31576 (ORNL/TM—9412) **Radiolytic gas generation rates from Hanford RHO-CAW sludge and double-shell slurry immobilized in grout.** Friedman, H.A.; Dole, L.R.; Gilliam, T.M.; Rogers, G.C. (Oak Ridge National Lab., TN (USA)). Jun 1985. Contract AC05-84OR21400. 63p. NTIS, PC A04/MF A01; GPO Dep. File Number DE85013519.

Cement-based grouts will be used to immobilize low-level waste solutions at the Rockwell Hanford Operations (RHO) in Richland, Washington. The radioactivity in these aqueous encapsulated waste solutions can cause decomposition of the pore water in these grouts. Concern has been expressed over the potential for pressurizing the waste packages used to contain this material and the flammability and explosion hazards from hydrogen gas from this decomposition. Oak Ridge National Laboratory (ORNL) undertook the task of establishing the radiolytic gas production rates for the two types of RHO waste streams - current acid waste (CAW) and double-shell slurry (DSS) - and determining the composition of the generated gases, the effects of surface-to-volume ratio of the samples, waste slurry particle sizes, and the water content of the waste form. The alpha exposure of the grouts containing RHO-CAW sludge (with NO_3^-) produced H_2 and O_2 at almost a 2:1 ratio, with a trace of N_2O. The alpha irradiation of the grouts containing the DSS solution (with both NO_3^- and NO_2^-) produced mainly N_2O, H_2, and a trace of CH_4. In this case, O_2 and N_2 were either produced or consumed, depending upon when the sample was collected. During the gamma radiolysis of the grouts containing the DSS solution, N_2O, H_2O, N_2, and a trace of CH_4 were produced. In this case, O_2 from the air in the system was consumed. The average G/sub t/ value for the grout containing the RHO-CAW sludge exposed to alpha irradiation was 0.42 molec/100 eV, which is close to that for the gamma exposure of pure water (0.45 molec/100 eV). A G/sub t/ value of 0.12 molec/100 eV was obtained for the grout containing the DSS solution from the alpha exposure. As expected, a smaller G/sub t/ value of 0.018 molec/100 eV was obtained for the gamma exposure of the grout with DSS solutions.

31577 (PB—85-171452/XAB) **Effects of acid deposition on the properties of portland cement concrete: state of knowledge.** Webster, R.P.; Kukacka, L.E. (Brookhaven National Lab., Upton, NY (USA)). Feb 1985. 44p. NTIS, PC A03/MF A01.

Presented are the results of a program conducted to determine the state-of-the-art knowledge pertaining to the effects of acid deposition on the properties of portland cement concrete structures. Information was collected from a computerized literature survey, interviews, and replies to mail and telephone inquiries addressed to cement and concrete researchers and to governmental agencies and private firms active in the maintenance and restoration of concrete structures.

31578 (PUC-TN—11/83) **Electric dipole ordering in alkali-cyanides: NaCN and KCN.** Koiller, B.; Davidovich, M.A.; Carmo, L.C.S. do; Luety, F. (Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Fisica). 1983. 19p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85701429.

A simple model for the low temperature electrically ordered state of NaCN and KCN is presented. The model takes into account electric dipole dressing effects which include cationic displacements determined experimentally. The ground state structure and the calculated values for the local electric fields are in fair agreement with experimental results. A parametrization for the elastic potencial confirms the plausibility of these model.

31579 (SAND—84-2287C) **Dangling bonds and sub-gap optical absorption in silicon.** Seager, C.H.; Lenahan, P.M.; Brower, K.L.; Mikawa, R.E. (Sandia National Labs., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 7p. (CONF-850421—5). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85011752.

From 2. spring meeting of the Materials Research Society; San Francisco, CA, USA (15 Apr 1985).

The silicon "dangling bond" defect plays a large part in controlling the electronic properties of a-Si, polycrystalline silicon, and Si/SiO_2 interface. Jackson et al. have suggested that transitions of electrons occupying this defect produce the Urbach-like sub-gap absorption tail seen in two of these materials. We have performed optical and electron spin resonance measurements on polycrystalline silicon, plastically deformed silicon, and Si/SiO_2 interfaces to further examine this contention. In addition to seeing no measurable absorptance due to dangling bond interface states in the latter system, we conclude from the poor correlation of ESR signals with optical data that the Urbach tail in polycrystalline and deformed silicon is not due to transitions of dangling bond electrons.

31580 (SAND—85-0947) **Shock and release equation of state of calcite.** Grady, D.E.; Moody, R.L. (Sandia National Labs., Albuquerque, NM (USA)). May 1985. Contract AC04-76DP00789. 26p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85013151.

Studies were initiated to investigate the unloading response of carbonate minerals from high-pressure Hugoniot states between 10 to 100 GPa. A two-stage gun facility was used. Several impact experiments are reported on crystallite calcite for shock pressure below 10 GPa. Results are compared with other Hugoniot data on various calcium carbonate rocks and minerals. 11 figs. (DLC)

31581 **(UCRL—91429) Pulse duration dependence of 1064-nm laser damage thresholds of porous silica antireflection coatings on fused silica substrates.** Milam, D.; Thomas, I.M.; Weinzapfel, C.; Wilder J.G. (Lawrence Livermore National Lab., CA (USA)). 30 May 1985. Contract W-7405-ENG-48. 15p. (CONF-8410276—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE85013207.

From Boulder damage symposium; Boulder, CO, USA (15 Oct 1984).

We used 1064-nm pulses with durations of 1, 5, 9 ns to measure laser-damage thresholds of 10 porous silica antireflection coatings deposited from both methanol and ethanol solutions containing silica particles with diameters of 10-20 nm. The median thresholds measured at the three pulse durations, 10.8 J/cm^2, 26.5 J/cm^2, and 38 J/cm^2, scaled as pulse duration to the 0.56 power. 4 refs., 3 figs., 1 tab.

31582 **(UCRL—92682) Single-point diamond crushing of Zerodur with in-situ polishing and metrology on a diamond turning machine.** Bryan, J.B.; Carter, D.L. (Lawrence Livermore National Lab., CA (USA)). 1 Apr 1985. Contract W-7405-ENG-48. 11p. (CONF-8504139—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE85012918.

From Glancing incident optics-fabrication workshop; Annapolis, MD, USA (1 Apr 1985).

Large, complicated, aspherical optical elements of glass are presently used in many astronomical devices, both on land and in space. Grazing-incident mirrors are envisioned for use in such missions as the proposed Advanced X-Ray Astrophysical Facility (AXAF), the Far Ultraviolet Spectroscopic Explorer (FUSE), and others. These elements are very expensive to fabricate because a great deal of time and labor are required to shape a glass blank. The fabrication of these mirrors can best be achieved by applying precision machining techniques and precision machines for figuring and finishing low-expansion glasses such as Zerodur.

31583 **Vacuum surface flashover: A high-pressure phenomenon.** Gray, E.W. (Sandia National Laboratories, Albuquerque, New Mexico, 87185). *Journal of Applied Physics;* **58**: No. 1, 132-141(1 Jul 1985).

Desorbed gases from insulator surfaces may be much more important in flashover initiation than properties of the dielectric surface. Ambient neutral densities, immediately above the insulator surface, in the initial stages of flashover have been calculated to lie in the range from 2 x 10^{17}/cm^3 to 2 x 10^{21}/cm^3 with a mean of about 1 x 10^{19}/cm^3, whether flashover occurred on surfaces in air at atmospheric pressure or in vacuum as low as 10^{-6} Torr. The evidence presented indicates that, for dc and microsecond pulse voltages, surface flashover is a local, relatively high-pressure phenomenon. Comparison of field strengths of surface flashover for various insulating materials perpendicular to the electrodes, operating pressures, and voltage waveforms appears to indicate that flashover values range well within an order of magnitude (~18—80kV/cm). A filamentary nature of the flashover discharge is shown and is consistent with gas breakdown phenomena. Ionization wave front velocities are examined and these compare favorably with those obtained from gaseous breakdown studies.

31584 **Theory of deep level trap effects on generation-recombination noise in HgCdTe photoconductors.** Iverson, A.E.; Smith, D.L. (Program in Applied Mathematics, University of Arizona, Tucson, Arizona 85721 and Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Applied Physics;* **58**: No. 1, 579-587(1 Jul 1985).

We present a theory of the effect of deep level centers on the generation-recombination (g-r) noise and responsivity of an intrinsic photoconductor. The deep level centers can influence the g-r noise and responsivity in three main ways: (i) they can shorten the bulk carrier lifetime by Shockley—Read—Hall recombination; (ii) for some values of the capture cross sections, deep level densities, and temperature, the deep levels can trap a significant fraction of the photogenerated minority carriers. This trapping reduces the effective minority carrier mobility and diffusivity and thus reduces the effect of carrier sweep out on both g-r noise and responsivity; (iii) the deep level centers add a new thermal noise source, which results from fluctuations between bound and free carriers. The strength of this new noise source decreases with decreasing temperature at a slower rate than band-to-band thermal g-r noise. Calculations have been performed for a X = 0.21, n-type Hg/sub 1-x/Cd/sub x/Te photoconductor using the parameters of a commonly occurring deep level center in this material. We find that for typical operating conditions photoconductive detector performance begins to degrade as the deep level density begins to exceed 10^{16} cm^{-3}.

31585 **Radiation-induced transient acoustic loss in quartz crystals.** Koehler, D.R.; Martin, J.J. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of Applied Physics;* **57**: No. 12, 5205-5210(15 Jun 1985). Contract AC04-76DP00789.

When exposed to pulsed ionizing radiation, quartz oscillator crystals can exhibit transient acoustic losses (a decrease in Q) and transient frequency shifts. Although these changes are usually most pronounced in unswept quartz, they have also been seen in swept quartz. We have directly measured the transient acoustic loss in both synthetic and natural quartz. The synthetic quartz samples included hydrogen and lithium swept units. Irradiations were accomplished at REBA, a flash x-ray facility at Sandia Laboratories. Log decrement acoustic loss measurements were made over the 110—400 K temperature range and show a time dependence similar to a t^{-1}/sup //^{2} behavior characteristic of one-dimensional diffusion. The transient loss showed a broad temperature dependence ascribed to alkali ions moving along the Z-axis channels. Peaks at 360 and 380 K in the transient loss temperature spectra are thought to be due to an unstable defect which momentarily traps the alkali ion.

31586 **Solid-solid phase transitions and soft phonon modes in highly condensed Si.** Chang, K.J.; Cohen, M.L. (Department of Physics, University of California, Berkeley, California 94720 and Materials and Molecular Research Division, Lawrence Berkeley National Laboratory, Berkeley, California 94720). *Physical Review [Section] B: Condensed Matter;* **31**: No. 12, 7819-7826(15 Jun 1985).

The pseudopotential method is used to examine the structural transitions of Si from β-Sn to simple hexagonal (sh) to hexagonal close packed (hcp). The calculated transition pressures, transition volumes, and c/a ratios are in good agreement with the measured values. Furthermore, the phase-transition pressure from hexagonal close packed to face-centered cubic is predicted to be 1.2 Mbar. The phonon frequencies are also calculated with use of the frozen-phonon approximation for the β-Sn, sh, and hcp phases. For both the β-Sn and sh phases, pressure-sensitive soft phonon modes exist. These are the longitudinal optic mode at the Brillouin-zone center for β-Sn and the transverse acoustic mode at the Brillouin-zone boundary for sh in the [001] direction. These soft modes are most likely associated with the phase transformations from β-Sn to sh to hcp. The metallic sh phase has strong covalent interlayer bonding. This is opposite to the case for the graphite structure. The weak bonding in the hexagonal plane of the sh phase causes the soft transverse mode for this phase.

31587 **Intensities and asymmetries of electronic Raman scattering in $ErPO_4$ and $TmPO_4$.** Becker, P.C.; Edelstein, N.; Williams, G.M.; Bucher, J.J.; Russo, R.E.; Koningstein, J.A.; Boatner, L.A.; Abraham, M.M. (Materials and Molecular Research Division, Lawrence Berkeley Laboratory, Berkeley, California 94720 and Department of Physics, University of California, Berkeley, California 94720). *Physical Review [Section] B: Condensed Matter;* **31**: No. 12, 8102-8110(15 Jun 1985).

An investigation of the low-temperature electronic Raman scattering spectra of $ErPO_4$ and $TmPO_4$ has been carried out. The experimental intensities have been compared with the standard second-order theory of two-photon processes for both intermultiplet and intramultiplet transitions between individual crystal-field levels. Adequate agreement is found in the case of $ErPO_4$, but serious discrepancies exist for $TmPO_4$. It is shown that electronic Raman scattering is a sensitive technique for testing the Judd-Ofelt—type theories of two-photon processes in rare-earth crystals. Strong asymmetry, a characteristic feature of electronic Raman scattering, has been observed in several of the transitions.

31588 **Chemical trends in ground- and excited-state properties of interstitial 3d impurities in silicon.** Katayama-Yoshida, H.; Zunger, A. (Solar Energy Research Institute, Golden, Colorado 80401). *Physical Review [Section] B: Condensed Matter;* **31**: No. 12, 8317-8320(15 Jun 1985).

A spin-polarized local-density Green's-function calculation for tetrahedral interstitial 3d impurities in silicon reveals a new energy-level scheme that explains the observed chemical trends both in ground-state properties (hyperfine coupling constants and g values) and in excited-state properties (donor and acceptor ionization energies).

31589 **Observation of a C-1s core exciton in diamond.** Morar, J.F.; Himpsel, F.J.; Hollinger, G.; Hughes, G.; Jordan, a.J.L. (IBM Thomas J. Watson Research Center, Box 218, Yorktown Heights, New York 10598). *Physical Review Letters;* **54**: No. 17, 1960-1963(29 Apr 1985).

A well-resolved core exciton at the bulk diamond C-1s absorption edge has been observed using high-resolution partial-yield spectroscopy with synchrotron radiation. The obtained excitonic binding energy, 0.19 +- 0.015 eV, agrees well with a first-principles effective-mass approximation (EMA). This is in sharp contrast to other semiconductors (Si, Ge, and GaAs) where reported excitonic shifts far exceed EMA estimates. In light of these results, one must question whether previous measurements overestimate the core-hole interaction or if they indicate a breakdown of the EMA for core excitons.

31590 **Neutron diffraction study of natrolite, $Na_2Al_2Si_3O_{10}.2H_2O$, at 20 K.** Artioli, G.; Smith, J.V. (Chicago Univ., IL (USA). Dept. of Geophysical Sciences); Kvick, Aa. (Brookhaven National Lab., Upton, NY (USA)). *Acta Crystallographica, Section C: Crystal Structure Communications;* **40**: No. 10, 1658-1662(15 Oct 1984).

Msub(r) = 3041.84, orthorhombic, Fdd2, a = 18.272 (6), b = 18.613 (6), c = 6.593 (2) A, V = 2242 (2) A^3, Z = 8, Dsub(x) = 2.25 g cm^{-3}, Ge(331)-monochromatized neutrons, lambda = 0.8263 (1) A, $\mu = 0.404$ cm^{-1}, 20 K, $R(F^2) = 0.044$ (1976 reflections). The tetrahedral sites have complete Al_2Si_3 order. Although the Si-O and Al-O distances correlate inversely with the Si-O-Al angle as for other ordered fibrous zeolites, there are differences which may relate to the ionic potential of the extraframework cations.

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4001 Analytical And Separations Chemistry

REFER ALSO TO CITATION(S) 29654, 29790, 29858, 29858, 29883, 29887, 29920, 29984, 29992, 30038, 30039, 30044, 31552, 31671, 31714, 32054, 32055, 32333

31591 **(BARC—1207) Synthesis of tetrabutyl tin and its performance characteristics in liquid scintillation counting for radioimmunoassay.** Iyengar, T.S.; Vaze, P.K.; Dhane, D.L.; Gaiki, G.M. (Bhabha Atomic Research Centre, Bombay (India)). 1983. 15p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85900995.

The preparation, purification and identification of tetra-n-butyl tin is described. Its performance in liquid scintillation counting of the low-energy gamma emitter, iodine-125 used in radioimmunoassay and optimization of the counting procedures with special vials are also reported. 4 refs., 4 figs., 4 tabs.

31592 **(DEMO—83/12G) Parameters of chambers for radon extraction from liquid samples.** Kritidis, P. (Democritos Nuclear Research Center, Athens (Greece)). Sep 1983. 13p. (In Greek). NTIS (US Sales Only), PC A02;MF A01. File Number DE85701507.

The parameters influencing radon deemanation from water samples are examined on the basis of four different models concerning finite sample- and continuous measurements. Expressions are derived for a properly defined deemanation coefficient, the water-to-air 1/1 liter radon transfer and the radon outlet flow rate, as functions of air and water flow rates, the solubility coefficient of radon in water and other characteristic parameters. The linear-shaped deemanator with inverse air and water flows is found to provide more intensive radon extraction, as compared with one involving quick homogenization of radon concentrations within its volume.

31593 **(DEMO—83/14) Accumulation of radon in a measuring chamber during different variants of measurement.** Kritidis, P.; Mivev, L.; Uzunov, I. (Democritos Nuclear Research Center, Athens (Greece)). Oct 1983. 16p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85701508.

Accumulation of radon in a scintillation or ionization chamber has been studied on the basis of a simple general model. The expressions derived apply to a number of different procedures for determination of radon concentrations in air, water and soil gas. Certain conclusions have been drawn concerning, for instance, the selection of extraction procedure for single and for continuous measurements of radon in water.

31594 **(DOE/ER/13202—1) Studies of the analyte-carrier interface in multicomponent flow injection analysis, June 1, 1984-March 15, 1985.** Brown, S.D. (Washington State Univ., Pullman (USA). Dept. of Chemistry). 1985. Contract FG06-84ER13202. 6p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85010615.

This project involves the use of digital filtering techniques to analyze the responses obtained by a scanning detector in a flow injection system. Detection is primarily by rapid-scan square-wave voltammetry, with multiple square-wave voltammograms obtained within the time it takes a single injected bolus to pass through the detector. Mathematical analysis of the data obtained from the rapid-scan detector is accomplished by various forms of the Kalman filter, a recursive digital filter. Objectives include the demonstration of multicomponent analysis using flow injection, and the study of diffusion-controlled chemical reactions between the components of an injected sample plug and reagents present in the carrier solution. During the past nine months, we have presented two talks on the results of our early work on the flow injection studies with the lead-thallium test system. We have demonstrated a detection limit near 10^{-6} M for both species using the flow detector and we observed that mixtures (with concentration ratios of up to 10:1, with either component in excess) could be analyzed with accuracies around 5%. We have also published a short paper on the limits of a similar resolution in static (no flow) systems.

31595 **(DPST—85-273) Reaction of uranium and the fluorocarbon FC-75.** Young, R.H. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 4 Apr 1985. Contract AC09-76SR00001. 21p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85012322.

Because of criticality concerns with water cooling in enriched uranium upgrading, a fluorocarbon has been evaluated as a replacement coolant for internal module components in the Plasma Separation Process (PSP). The interaction of bulk uranium and of powdered uranium with FC-75 has been investigated at temperatures between 200 and 700°C. The gas pressure and the metal temperature were monitored as a function of time. Modest temperature changes of 50 to 100°C were observed for the bulk uranium/fluorocarbon reaction. Much larger changes (up to 1000°C) were noted for the reaction involving high surface area uranium powder. These temperature transients, particularly for the powdered uranium reaction, were short-lived (<10 seconds) and indicative of the formation of a protective layer of reaction products. Analysis of residual gas products by infrared spectroscopy indicated that one potentially serious hazard, UF_6, was not present; however, several small toxic fluorocarbons were produced by thermolysis and/or reaction. X-ray diffraction analysis of the residual solids indicated UF_4 and UO_2 were the major solid products. 5 refs., 11 figs., 1 tab.

31596 **(IA—1404, pp 136-137) Model for identification and quantitative analysis of materials by x-ray fluorescence.** Segal, D. Jul 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85780940.

Published in summary form only.
In Research laboratories annual report 1983.

31597 (IAEA-TECDOC—323) **Quality assurance in biomedical neutron activation analysis. Report of an advisory group meeting organized by the IAEA and held in Vienna, 13-17 September 1982.** (International Atomic Energy Agency, Vienna (Austria)). Nov 1984. 208p. (CONF-8209272—Summ.). NTIS (US Sales Only), PC A10/MF A01. File Number DE85780941.

From Advisory group meeting on quality assurance in biomedical neutron activation analysis; Vienna, Austria (13 Sep 1982).

The summary report represents an attempt to identify some of the possible sources of error in in vitro neutron activation analysis of trace elements applied to specimens of biomedical origin and to advise on practical means to avoid them. The report is intended as guidance for all involved in analysis, including sample collection and preparation for analysis. All these recommendations constitute part of quality assurance which is here taken to encompass the two concepts - quality control and quality assessment. Quality control is the mechanism established to control errors, while quality assessment is the mechanism used to verify that the analytical procedure is operating within acceptable limits.

31598 (IAEA-TECDOC—323, pp 39-51) **Relative accuracy, precision and frequency of use of neutron activation analysis and other techniques as revealed by the results of some recent IAEA intercomparisons.** Dybczynski, R. (Institute of Nuclear Research, Warsaw (Poland)). Nov 1984. NTIS (US Sales Only), PC A10/MF A01. File Number DE85780941. (CONF-8209272—Summ.).

From Advisory group meeting on quality assurance in biomedical neutron activation analysis; Vienna, Austria (13 Sep 1982).

Results of some IAEA intercomparisons organised during the past 10 years are examined with special reference to the analysis of materials of bio-environmental relevance. Overall, neutron activation analysis (NAA) contributed a greater fraction of the results than any other technique. Literature data for NBS reference materials also reveals a high frequency of use of NAA. It is concluded that NAA is now a mature technique that provides results of satisfactory accuracy and precision for many trace elements. Relatively frequently, however, results reported by individual laboratories can be identified as outliers, indicating that systematic errors are a common occurrence with NAA as with other trace analysis techniques.

31599 (IAEA-TECDOC—323, pp 53-69) **Need for improved quality assurance in biomedical neutron activation analysis as revealed by the results of some recent IAEA intercomparisons.** Parr, R.M. (International Atomic Energy Agency, Vienna (Austria)). Nov 1984. NTIS (US Sales Only), PC A10/MF A01. File Number DE85780941. (CONF-8209272—Summ.).

From Advisory group meeting on quality assurance in biomedical neutron activation analysis; Vienna, Austria (13 Sep 1982).

Results of three IAEA intercomparisons with animal muscle (H-4), animal bone (H-5) and human hair (HH-1) are examined and compared with the predictions of Guinn and Hoste as regards the precision that should be attainable by neutron activation analysis (NAA) techniques. In practice, there are wide discrepancies between the results reported by different laboratories which far exceed the predicted precisions. Ca, Cl, Cu, Fe, K, Mg, Se and Zn exhibit the smallest variability; As, Hg, I and Mn occupy an intermediate position; and Cd, Co, Cr, Mo and Sb show extreme variability (up to several orders of magnitude). It is concluded that these problems are caused, in part, by the use of an inappropriate technique, e.g. instrumental NAA instead of radiochemical NAA.

31600 (IAEA-TECDOC—323, pp 71-82) **Collection and manipulation of samples for trace element analysis. Quality assurance considerations.** Versieck, J. (Department of Internal Medicine, Div. of Gastroenterology, University Hospital, Ghent (Belgium)). Nov 1984. NTIS (US Sales Only), PC A10/MF A01. File Number DE85780941. (CONF-8209272—Summ.).

From Advisory group meeting on quality assurance in biomedical neutron activation analysis; Vienna, Austria (13 Sep 1982).

Evidence has accumulated that inadequate sample collection and manipulation is a virulent source of error in trace element analysis. There are a number of factors that threaten sample integrity - undoubtedly, contamination with exogenous material is the most important. This working paper concentrates on the errors that may be introduced during the collection and manipulation of blood and serum samples.

31601 (IAEA-TECDOC—323, pp 107-119) **Preparation and use of chemical irradiation standards.** Byrne, A.R. (Institut Jozef Stefan, Ljubljana (Yugoslavia)). Nov 1984. NTIS (US Sales Only), PC A10/MF A01. File Number DE85780941. (CONF-8209272—Summ.).

From Advisory group meeting on quality assurance in biomedical neutron activation analysis; Vienna, Austria (13 Sep 1982).

Problems and errors associated with the use of chemical standards in neutron activation are discussed, particularly aqueous solutions used in trace analysis, with emphasis on radiochemical methods. Practical experience with problem-free solutions is given, and some pitfalls mentioned, together with recommendations for reducing errors likely to arise in the use of such standards.

31602 (IAEA-TECDOC—323, pp 121-124) **Error sources involved in pre-irradiation separations.** Goeij, J.J.M. de (Interuniversitair Reactor Inst., Delft (Netherlands)). Nov 1984. NTIS (US Sales Only), PC A10/MF A01. File Number DE85780941. (CONF-8209272—Summ.).

From Advisory group meeting on quality assurance in biomedical neutron activation analysis; Vienna, Austria (13 Sep 1982).

Contamination and other error sources in pre-irradiation separations in biomedical neutron activation analysis are discussed. These separations may be used for differentiation of the matrix as to cell types and cell constituents, (bio)chemical speciation of the analyte, removal of interfering elements, and/or concentration of the analyte.

31603 (IAEA-TECDOC—323, pp 125-148) **Sources of errors in reactor neutron activation analysis of biological samples.** Sankar Das, M. (Bhabha Atomic Research Centre, Bombay (India). Analytical Chemistry Div.). Nov 1984. NTIS (US Sales Only), PC A10/MF A01. File Number DE85780941. (CONF-8209272—Summ.).

From Advisory group meeting on quality assurance in biomedical neutron activation analysis; Vienna, Austria (13 Sep 1982).

This paper focusses some of the sources of errors in Neutron Activation Analysis of biological samples arising from contamination of samples during irradiation, flux variation during irradiation, threshold reaction interferences and typical spectral interferences in quantitation. Use of reference samples as comparators in the preparation of new standards can lead to hereditary transfer of errors. To assess the analytical data in INAA use of ion-exchange resin loaded standards allow the preparation of required compositions. The importance of S/N ratio in quantitation by NAA is demonstrated.

31604 (IAEA-TECDOC—323, pp 149-152) **Optimization of reactor neutron activation analysis conditions.** Guinn, V.P. (California Univ., Irvine (USA). Dept. of Chemistry). Nov 1984. NTIS (US Sales Only), PC A10/MF A01. File Number DE85780941. (CONF-8209272—Summ.).

From Advisory group meeting on quality assurance in biomedical neutron activation analysis; Vienna, Austria (13 Sep 1982).

BASIC-PLUS and FORTRAN-4.

Analyses of the maximum precision attainable, under given neutron flux and other conditions, can be achieved, possible errors avoided, and much time saved by using an INAA Advance Prediction Computer Program prior to actual analyses. Such an APCP is described, and its availability indicated.

31605 (IAEA-TECDOC—323, pp 153-161) **Error sources involved in radiochemical processing.** Goeij, J.J.M. de (Interuniversitair Reactor Inst., Delft (Netherlands)). Nov 1984. NTIS (US Sales Only), PC A10/MF A01. File Number DE85780941. (CONF-8209272—Summ.).

From Advisory group meeting on quality assurance in biomedical neutron activation analysis; Vienna, Austria (13 Sep 1982).

Error sources typical for radiochemical processing in destructive neutron activation analysis of biomedical samples are discussed. Main aspects considered are: transfer of the irradiated sample from the irradiation container, addition of carrier, mineralization, chemical separation, determination of the chemical yield, calibration standards, blank correction, and contamination control.

31606 (IAEA-TECDOC—323, pp 163-177) **Gamma-ray spectroscopy in neutron activation analysis: sources of error.** Bruin, M. de (Interuniversitair Reactor Inst., Delft (Netherlands)). Nov 1984. NTIS (US Sales Only), PC A10/MF A01. File Number DE85780941. (CONF-8209272—Summ.).

From Advisory group meeting on quality assurance in biomedical neutron activation analysis; Vienna, Austria (13 Sep 1982).

The errors resulting from the gamma-ray spectrometric part of a neutron activation analysis may contribute considerably to the total analytical error. The major sources of these errors are discussed, including those associated with geometry, dead-time, summation and pile-up, detection and calculation of spectrum peaks and their assignment to specific radionuclides.

31607 (IAEA-TECDOC—323, pp 179-190) **Internal quality assurance in biomedical neutron activation analysis.** Heydorn, K. (Risoe National Lab., Roskilde (Denmark)). Nov 1984. NTIS (US Sales Only), PC A10/MF A01. File Number DE85780941. (CONF-8209272—Summ.).

From Advisory group meeting on quality assurance in biomedical neutron activation analysis; Vienna, Austria (13 Sep 1982).

In neutron activation analysis standard deviations of individual results are estimated from a priori precision and counting statistics, and sample heterogeneity is taken into account by a sampling constant. Statistical control means agreement between observed and estimated variability; additional sources of variation, including contamination during sampling, are detected by stepwise application of the Analysis of Precision.

31608 (IAEA-TECDOC—323, pp 191-201) **External quality control.** Bowen, H.J.M. (Reading Univ. (UK). Dept. of Chemistry). Nov 1984. NTIS (US Sales Only), PC A10/MF A01. File Number DE85780941. (CONF-8209272—Summ.).

From Advisory group meeting on quality assurance in biomedical neutron activation analysis; Vienna, Austria (13 Sep 1982).

Quality control of chemical analyses of biological materials is discussed, with especial reference to tests using certified biological reference materials.

31609 **(INIS-mf—9300) Kinetics of mass transfer on a drop bundle in the system uranyl nitrate nitric acid/tributyl phosphate, kerosene.** Schuster, U. (Technische Univ. Muenchen (Germany, F.R.). Fakultaet fuer Maschinenwesen). 2 Feb 1984. 286p. (In German). NTIS (US Sales Only), PC A13/MF A01. File Number DE85780931.

With 129 refs.

The dissertation discusses the kinetics of the coupled exchange of nitric acid and uranyl nitrate between water and tributylphosphate-burdened kerosene. Preliminary to column design, mass exchange measurements were carried out on a monodisperse droplet bundle according to a method not described so far. The concentration range investigated, i.e. $1x10^{-5} < UO_2(NO_3)_2 < 5x10^{-1}$ kmol/m^3, HNO_3 = 2,4 kmol/m^3, TBP = 30 Vol.% (TBP-Tributylphosphat), meets the technical standards. (orig.).

31610 (INIS-mf—9625, pp 5) **Analysis of materials by RBS and PIXE.** Bajer, R.; Dzmuran, R.; Hnatowicz, V.; Kvitek, J.; Novy, F. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderne Fyziky); Obrusnik, I.; Vidra, M. (Ustav Jaderneho Vyzkumu CSKAE, Rez (Czechoslovakia)); Odzajev, V. (Ceske Vysoke Uceni Technicke, Prague (Czechoslovakia). Fakulta Elektrotechnicka). Oct 1984. (In Czech). NTIS (US Sales Only), PC A03/MF A01. File Number DE85780928. (CONF-8410254—Absts.).

From IAA '84 - seminar on instrumental activation analysis; Klucenice, Czechoslovakia (29 Oct 1984).

Published in summary form only.

31611 (INIS-mf—9625, pp 6) **Interference in instrumental neutron activation analysis.** Vobecky, M. (Ceskoslovenska Akademie Ved, Prague. Ustav Nuklearni Biologie a Radiochemie). Oct 1984. (In Czech). NTIS (US Sales Only), PC A03/MF A01. File Number DE85780928. (CONF-8410254—Absts.).

From IAA '84 - seminar on instrumental activation analysis; Klucenice, Czechoslovakia (29 Oct 1984).

Published in summary form only.

31612 (INIS-mf—9625, pp 24-26) **List of important sources of nuclear data for neutron activation analysis and gamma spectrometry.** Posta, S. (Ustav Jaderneho Vyzkumu CSKAE, Rez (Czechoslovakia)). Oct 1984. (In Czech). NTIS (US Sales Only), PC A03/MF A01. File Number DE85780928. (CONF-8410254—Absts.).

From IAA '84 - seminar on instrumental activation analysis; Klucenice, Czechoslovakia (29 Oct 1984).

A list is given of 64 relevant references, classified according to the type of reported data: data on elements, on neutron nuclear reactions, radioactive decay, or gamma-ray interaction with matter. For most references an evaluation is given as to the reliability of the data presented. (A.K.).

31613 **(INIS-mf—9625) Abstracts of papers from seminar on instrumental activation analysis.** (Ceskoslovenska Komise pro Atomovou Energii, Prague). Oct 1984. 30p. (In Czech). (CONF-8410254—Absts.). NTIS (US Sales Only), PC A03/MF A01. File Number DE85780928.

From IAA '84 - seminar on instrumental activation analysis; Klucenice, Czechoslovakia (29 Oct 1984).

Published in summary form only.

Selected papers have been processed for inclusion in the Energy Data Base.

31614 **(INS-M—75) Rb-Sr system. Chemical procedures.** Graham, I.J. (Department of Scientific and Industrial Research, Lower Hutt (New Zealand). Inst. of Nuclear Sciences). Nov 1983. 53p. NTIS (US Sales Only), PC A04/MF A01. File Number DE85701451.

This manual is intended to serve as a guide to the chemical procedures involved in Rb-Sr isotopic analysis as conducted at the Institute of Nuclear Sciences. Included are notes on the experimental developments made over the last 2.5 years, especially those involving rock dissolution and cation exchange chromatography.

31615 **(JINR—18-83-915) Optimization of measurement conditions at determining the nitrogen content in a grain using the gamma-activation method.** Zen Chan Uk; Zamyatnin, Yu.S.; Zhuchko, V.E. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1983. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85701027.

The yields of (γ, n) reactions on oxygen, nitrogen and carbon are determined experimentally at the irradiation of samples with bremsstrahlung of MT-22 microtron with 15.4 up to 21.3 MeV boundary energy. On the basis of these data optimum time for measurements of nitrogen activities and boundary energy of bremsstrahlung which provide best effect/background ratios and the least statistical error are determined. A technique is proposed for determining the nitrogen content with respect to carbon by means of successive registration of sample activity, which excludes sample weighting procedure. Optimum time momenta for measuring nitrogen and carbon activity are found.

31616 **(KFK—3868) Voltammetric assay of extremely low technetium concentrations following enrichment at the HMDE after reaction with Thiocyanate.** Friedrich, M.; Ruf, H. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Radiochemie; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Wiederaufarbeitung und Abfallbehandlung). Dec 1984. 16p. (In German). (PWA—103/84). NTIS (US Sales Only), PC A02/MF A01. File Number DE85751643.

It is known that in sulfuric acid solution pertechnetate is reduced by thiocyanate to form thiocyanate complexes. After this reaction the technetium acquires the capability of being adsorbed at the hanging mercury drop electrode (HMDE) provided that a potential of -0,40 V (vs. Ag/AgCl) has been applied to the electrode. If, by application of the differential pulse voltammetry after the phase of deposition the potential at the electrode is scanned cathodically, traces of technetium can be determined very sensitively by evaluation of the peak current recorded at minus 1,27 V (Ag/AgCl). The effect is still being enhanced by the presence of not interfering small perrhenate amounts. The reproducibility of the measured values is excellent.

31617 **(N—85-17430) Comparative usefulness of flue gas oxygen and carbon dioxide analysis.** Horn, T. (British Gas Corp., London). 1984. 10p. British Library Lending Div., Boston Spa, England.

For the assessment of furnace equipment, the flue gas is usually examined. Flue gas losses and firing efficiency permit conclusions to be made about the excess of air. Oxygen concentration (O2 measurement) in the flue gas yields more information and is shown to be more precise than the determination of the carbon dioxide concentration (CO2 measurement).

31618 (NAC-AR—84-01, pp 193-196) **Report of the Van de Graaff Group: nuclear analysis. The search for molecular effects in range corrections in elemental determination by proton bombardment.** Olivier, O. (Stellenbosch Univ. (South Africa). Dept. of Chemistry); Peisach, M. 1984. NTIS (US Sales Only), PC A14/MF A01. File Number DE85780939.

In Annual report June 1984. [Council for Scientific and Industrial Research, Faure (South Africa). National Accelerator Center].

The proton bombardment of boron was studied in matrices consisting of a wide range of chemically pure boron compounds and mixtures of known composition. The gamma-ray spectrum of proton-irradiated pure boron showed intense peaks due to the 718 and 2124 keV coulomb excitation gamma-rays from ^{10}B and ^{11}B respectively and the 428 keV gamma-ray from the reaction $^{10}B(p,\alpha)^{7}Be$.

31619 (NAC-AR—84-01, pp 197-199) **Report of the Van de Graaff Group: nuclear analysis. Studies of South-West African interest.** Gihwala, D. (Department of Physical Sciences, Peninsula Technikon); Jacobson, L. (State Museum, Windhoek); Peisach, M.; Pineda, C.A. (Cape Provincial Administration). 1984. NTIS (US Sales Only), PC A14/MF A01. File Number DE85780939.

In Annual report June 1984. [Council for Scientific and Industrial Research, Faure (South Africa). National Accelerator Center].

Clays and pottery from the Kavango and Caprivi areas of northern South West Africa were analysed for trace element concentrations. The main purpose of the investigation was to analyse clays from known sources and the pottery produced therefrom, in order to evalute the extent to which the elemental composition of a pot resembles that of the clay from which it was made. PIXE and PIPPS analysis were used. Analysis of clays from the northern regions of South West Africa indicated that the Kalahari: sands contained minor and trace elements of a suprisingly uniform composition.

31620 (NAC-AR—84-01, pp 201-202) **Report of the Van de Graaff Group: nuclear analysis. Studies on the origin of archaeological gold objects.** Jacobson, L. (State Museum, Windhoek); Gihwala, D. (Department of Physical Sciences, Peninsula Technikon); Pineda, C.A. (Cape Provincial Administration); Peisach, M. 1984. NTIS (US Sales Only), PC A14/MF A01. File Number DE85780939.

Short note.

In Annual report June 1984. [Council for Scientific and Industrial Research, Faure (South Africa). National Accelerator Center].

31621 (NAC-AR—84-01, pp 201) **Report of the Van de Graaff Group: nuclear analysis. Determining the origin of 18th century Cape pottery.** Gihwala, D. (Department of Physical Sciences, Peninsula Technikon); Jacobson, L. (State Museum, Windhoek); Peisach, M.; Pineda, C.A. (Cape Provincial Administration); Vos, H.N. (Stellenbosch Museum, Stellenbosch). 1984. NTIS (US Sales Only), PC A14/MF A01. File Number DE85780939.

Short note.

In Annual report June 1984. [Council for Scientific and Industrial Research, Faure (South Africa). National Accelerator Center].

31622 (NAC-AR—84-01, pp 199-200) **Report of the Van de Graaff Group: nuclear analysis. Analysis of trace compositions for the identification of Woodstock glass.** Gihwala, D. (Department of Physical Sciences, Peninsula Technikon); Jacobson, L. (State Museum, Windhoek); Peisach, M.; Pineda, C.A. (Cape Provincial Administration); Van der Merwe, M.P.S. (Cultural History Museum, Cape Town); Vos, H.N. (Stellenbosch Museum, Stellenbosch). 1984. NTIS (US Sales Only), PC A14/MF A01. File Number DE85780939.

Short note.

In Annual report June 1984. [Council for Scientific and Industrial Research, Faure (South Africa). National Accelerator Center].

31623 (NAC-AR—84-01, pp 203-204) **Report of the Van de Graaff Group: nuclear analysis. Examination of Chinese ceramics and pottery excavated in the Cape.** Gihwala, D. (Department of Physical Sciences, Peninsula Technikon); Jacobsen, L. (State Museum, Windhoek); Peisach, M.; Pineda, C.A. (Cape Provincial Administration); Vos, H.N. (Stellenbosch Museum, Stellenbosch). 1984. NTIS (US Sales Only), PC A14/MF A01. File Number DE85780939.

Short note.

In Annual report June 1984. [Council for Scientific and Industrial Research, Faure (South Africa). National Accelerator Center].

31624 (NAC-AR—84-01, pp 203) **Report of the Van de Graaff Group: nuclear analysis. Qualitative analysis of isolated archaeological trade beads.** Peisach, M.; Pineda, C.A. (Cape Provincial Administration); Webley, L.E. (Stellenbosch Univ. (South Africa). Dept. of Archaeology). 1984. NTIS (US Sales Only), PC A14/MF A01. File Number DE85780939.

Short note.

In Annual report June 1984. [Council for Scientific and Industrial Research, Faure (South Africa). National Accelerator Center].

31625 (NAC-AR—84-01, pp 206) **Report of the Van de Graaff Group: nuclear analysis. Determination of silicon in crude and refined oils.** Pineda, C.A. (Cape Provincial Administration); Gihwala, D. (Department of Physical Sciences, Peninsula Technikon); Peisach, M.; Bain, C.A.R. (Nuclear Development Corp. of South Africa (Pty.) Ltd., Pelindaba, Pretoria). 1984. NTIS (US Sales Only), PC A14/MF A01. File Number DE85780939.

Short note.

In Annual report June 1984. [Council for Scientific and Industrial Research, Faure (South Africa). National Accelerator Center].

31626 (NAC-AR—84-01, pp 207-208) **Report of the Van de Graaff Group: nuclear analysis. The toxic effects of aluminium in vines.** Meyer, B.R.; Le Roux, E. (Nederburg Wines, Huguenot); Renan, M.J.; Peisach, M. 1984. NTIS (US Sales Only), PC A14/MF A01. File Number DE85780939.

Short note.

In Annual report June 1984. [Council for Scientific and Industrial Research, Faure (South Africa). National Accelerator Center].

31627 (NAC-AR—84-01, pp 213-216) **Report of the Van de Graaff Group: nuclear analysis. Trace element composition of maternal and infant serum determined by PIXE.** Heese, H.deV.; Dempster, W.S.; Kirsten, G.F. (Cape Town Univ. (South Africa). Inst. of Child Health); Peisach, M.; Pineda, C.A. (Cape Provincial Administration); Gihwala, D. (Department of Physical Sciences, Peninsula Technikon). 1984. NTIS (US Sales Only), PC A14/MF A01. File Number DE85780939.

Short note.

In Annual report June 1984. [Council for Scientific and Industrial Research, Faure (South Africa). National Accelerator Center].

31628 (NAC-AR—84-01, pp 210-211) **Report of the Van de Graaff Group: nuclear analysis. The effect of nicotine on the trace element composition of rat liver.** Matthews, J. (Department of Paramedical Sciences, Peninsula Technikon, Bellville); Maritz, G.S. (University of the Western Cape, Bellville (South Africa). Dept. of Physiological Sciences); Pineda, C.A. (Cape Provincial Administration); Gihwala, D. (Department of Physical Sciences, Peninsula Technikon); Peisach, M. 1984. NTIS (US Sales Only), PC A14/MF A01. File Number DE85780939.

Short note.

In Annual report June 1984. [Council for Scientific and Industrial Research, Faure (South Africa). National Accelerator Center].

31629 (NAC-AR—84-01, pp 205) **Report of the Van de Graaff Group: nuclear analysis. Forgeries and reprints of postage stamps.** Jacobsen, L. (State Museum, Windhoek); Gihwala, D. (Department of Physical Sciences, Peninsula Technikon); Pineda, C.A. (Cape Provincial Administration); Peisach, M. 1984. NTIS (US Sales Only), PC A14/MF A01. File Number DE85780939.

Short note.

In Annual report June 1984. [Council for Scientific and Industrial Research, Faure (South Africa). National Accelerator Center].

31630 (NAC-AR—84-01, pp 230, 232) **Report of the Van de Graaff Group: solid state and materials research. Backscattering analysis of metallic contacts to GaAs.** Pretorius, R.; Botha, A.P.; Booyens, H. (Council for Scientific and Industrial Research, Pretoria (South Africa). National Inst. for Materials Research). 1984. NTIS (US Sales Only), PC A14/MF A01. File Number DE85780939.

Short note.

In Annual report June 1984. [Council for Scientific and Industrial Research, Faure (South Africa). National Accelerator Center].

31631 (NAC-AR—84-01, pp 230-231) **Report of the Van de Graaff Group: solid state and materials research. The characterisation of anti-reflection layers by Rutherford backscattering spectrometry.** Pretorius, R.; Bezuidenhout, D.; Chinnery, D. (Council for Scientific and Industrial Research, Pretoria (South Africa). National Physical Research Lab.). 1984. NTIS (US Sales Only), PC A14/MF A01. File Number DE85780939.

Short note.

In Annual report June 1984. [Council for Scientific and Industrial Research, Faure (South Africa). National Accelerator Center].

31632 (NAC-AR—84-01, pp 209-210) **Report of the Van de Graaff Group: nuclear analysis. Environmental lead analysis.** Gihwala, D. (Department of Physical Sciences, Peninsula Technikon, Bellville); Peisach, M.; Mets, J. (Medical School, University of Cape Town); Van Heerden, J.J. (Department of Health Sciences, Peninsula Technikon, Bellville); Pineda, C.A. (Cape Provincial Administration). 1984. NTIS (US Sales Only), PC A14/MF A01. File Number DE85780939.

Short note.

In Annual report June 1984. [Council for Scientific and Industrial Research, Faure (South Africa). National Accelerator Center].

31633 (NIM—1945) **Analyses of the NIMROC reference samples for minor and trace elements.** Steele, T.W.; Wilson, A.; Goudvis, R.; Ellis, P.J.; Radford, A.J. (National Inst. for Metallurgy, Johannesburg (South Africa)). 28 Feb 1978. 219p. NTIS (US Sales Only), PC A10/MF A01. File Number DE85701452.

The results are given of all the determinations made by the cooperating laboratories of minor and trace elements in the 6 NIMROC rock samples prepared by the National Institute for Metallurgy in 1966. Relevant statistical data and a graphical display of the distribution of the results are given for the sets of results for each element. Recommended values are given for those elements in which the number of results and their quality are reasonably acceptable. A description is given of the procedures that were used in the estimation of these recommended values. Methods used for the analysis includes: X-ray fluorescence analysis, solvent extraction, absorption spectroscopy, electrodeposition, emission spectroscopy, gravimetric analysis, mass spectroscopy, neutron activation analysis, chromatography, radiometric analysis, spectrophotometry, volumetric analysis, combustion, distillation, fusion, and ion exchange.

31634 (NRCN—532) **Spectrochemical determination of impurities in aluminium alloys by DC arc technique.** Harel, A.; Segal, A.; Charvit, E.; Goldbart, Z. (Israel Atomic Energy Commission, Beersheba. Nuclear Research Center-Negev). Apr 1983. 20p. (In Hebrew). NTIS (US Sales Only), PC A02/MF A01. File Number DE85701453.

Two spectrochemical methods are described for the determination of 12 impurities in aluminium alloys. These methods are suitable for the determination of traces of the following elements in the range of 5-400 ppm: B, Cd, Cr, Cu, Mg, Mn, Ni, Pb, Sb, Sn, Ti, Zn.

31635 (SLU-ESO-TR—31-1983) **Methods of preserving leaf samples between defoliation and laboratory investigations.** Nilsson, L.O. (Swedish Univ. of Agricultural Sciences, Uppsala. Energy Forestry Project). 1983. 22p. (In English and Swedish). (EFP-TR—31-1983). NTIS (US Sales Only), PC A02/MF A01. File Number DE85750841.

A simple method to preserve leaf parameters between sampling and measurement is presented. Within one hour after artificial defoliation Salix leaves were killed by freezing. After storage at room temperature for 5 days inside closed plastic bags with a minimum of air, the changes in leaf area, dry weight and concentrations of N, P and K were relatively negligible. Because of respiration and stress, unfrozen leaves stored in the same way increased by 10 percent for concentrations of N, P and K whereas dry weight and area decreased by 10 and 5 percent, respectively. Shoots of Salix viminalis growing for one week as border stools, having better light conditions, increased their leaf-stem dry weight ratio in relation to shoots growing inside the plots. The increase was found to be about 10 percent as mean value from mid July to early October 1981.

31636 (UCRL—92731) **New directions in chemical analysis.** Hirschfeld, T.B. (Lawrence Livermore National Lab., CA (USA)). May 1985. Contract W-7405-ENG-48. 35p. (CONF-8504138—1). NTIS, PC A03/MF A01; GPO Dep. File Number DE85012930.

From IUCCP symposium; College Station, TX, USA (1 Apr 1985).

The last twenty years have seen a steady increase in the work load of analytical chemistry. A number of procedures have evolved in the analytical laboratory to deal with this increase in work load. By far, the most important one of these is the preponderance of lab automation. Because of the entrance of computers in the laboratories, we can achieve productivity increases that would have been inconceivable without them. The second new procedure that has evolved in analytical chemistry to cope with the work load increase has been the incorporation of systems engineering as a part of the analytical laboratory practice. This paper discusses in depth the role of personal computers and systems engineering in analytical chemistry.

31637 **(LA-tr—85-27) X-ray fluorescence analysis of uranium concentrates.** Diaz-Guerra, J.P.; Bayon, A.; Roca, M. (Los Alamos National Lab., NM (USA); Junta de Energia Nuclear, Madrid (Spain). Div de Quimica y Ambiente). May 1985. Contract W-7405-ENG-36. Translation of JEN-400, 1978. 28p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85013189.

Uranium concentrates were analyzed by x-ray fluorescence for the following impurities: arsenic, calcium, iron, molybdenum, phosphorus, silicon, sulfur, thorium, and vanadium. All of the impurities except arsenic can be determined simultaneously.

31638 **Optimization of detector-noise-limited infrared multiwavelength determinations.** Honigs, D.E.; Hieftje, G.M.; Hirschfeld, T. (Department of Chemistry, Indiana University, Bloomington, Indiana 47405 (D.E.H.,G.M.H.); and Lawrence Livermore National Laboratory, Livermore, California 94550 (T.H.)). *Applied Spectroscopy;* **39**: No. 2, 253-256(Mar 1985). Contract W-7405-ENG-48.

The existence of optimal absorbance levels for absorption spectrophotometry is well known. The corresponding phenomenon in the multi-wavelength measurements characteristic of correlation spectroscopy lends itself to a similar analysis. The resulting optimization equation is quite complex, but can be approximated for several simplified cases. For very similar absorbances among the set of used wavelengths, or for a situation where the absorbance multiplied by its weighting factor at a given wavelength is far greater than for all the others, the classical optimum at $A = 0.434$ still applies. For a uniform distribution of absorbance, the optimal maximum absorption is $A = 0.868$. The complex general case can be rearranged to calculate, given data at a given pathlength, what the optimum pathlength should be. In multiwavelength determinations, the optimal condition involves equal relative error in the largest and the smallest absorbance.

31639 **High-resolution self-scanning continuous wave dye laser.** Ramsey, J.M.; Whitten, W.B. (Oak Ridge National Lab., TN). *Analytical Chemistry;* **56**: No. 14, 2979-2981(Dec 1984). Contract AC05-84OR21400.

A continuous wave dye laser is coupled to an extracavity single-domain $BaTiO_3$ crystal which provides feedback that narrows the laser line width and the wavelength over a 25-nm range. It is shown that the laser keeps the narrow line width throughout the scan. The technique is demonstrated on the NaD lines produced in a hollow cathode lamp. The response is monitored by optogalvanic techniques. The spectra obtained are compared with those obtained from conventional mechanically tuned dye laser system. The resolution of the newly developed system is significantly enhanced over that of the existing systems.

31640 **Capillary supercritical fluid chromatography/mass spectrometry with electron impact ionization.** Smith, R.D.; Udseth, H.R.; Kalinoski, H.T. (Pacific Northwest Lab., Richland, WA). *Analytical Chemistry;* **56**: No. 14, 2971-2973(Dec 1984). Contract AC06-76RL01830.

A simple electron impact ionization source interface was developed for a combined capillary column supercritical fluid chromatography and mass spectrometry systems (SFC-MS). The sensitivity of the system was illustrated by the analysis of a sample containing 100 pg quantities of 4-aminobiphenyl, benzidine, and 3,3'-dichlorobenzidine. An analysis was also performed of the labile pesticide aldicarb. The latter analysis was performed additionally to determine the thermal effects of the chromatography. The total system was shown to enhance the flexibility of SFC-MS compared to standard liquid chromatography-mass spectrometry.

31641 **Cesium as an activatable tracer for studying biological intrusion of plant roots into waste burial areas.** Gladney, E.S.; Hakonson, T.E.; Muller, M. (Los Alamos National Lab., NM (USA)). *Journal of Radioanalytical and Nuclear Chemistry;* **84**: No. 2, 423-429(Nov 1984).

This paper discusses the use of stable Cs as an activatable tracer for measuring performance of plant root intrusion barriers for solid waste disposal site cover systems. Experiments conducted at small-scale demonstrate the effectiveness and practicality of the technique and suggest that the methodology has application to a better understanding of plant root ecology.

31642 **Systematics of multielement determination with resonance ionization mass spectrometry and thermal atomization.** Moore, L.J.; Fassett, J.D.; Travis, J.C. (National Bureau of Standards, Gaithersburg, MD). *Analytical Chemistry;* **56**: No. 14, 2770-2775(Nov 1984).

The systematics for multielement determination using resonance ionization mass spectrometry and thermal atomization is developed. The aspects of atomization, ionization, and detection are discussed and resonance ionization is demonstrated for 19 elements. The selective, sequential ionization of seven elements from a single sample is also demonstrated. A one-wavelength, two-photon ionization scheme generally is used in which the first photon excites a bound transition in the near-ultraviolet region and second photon promotes the electron into theionization continuum. The wavelength-dependence ion formation from the thermally produced atom reservoirs is demonstrated for these elements by scanning a Nd:YAG-pumped dye laser across its tunable wavelength range. The observed wavelengths where ionization occurs have been correlated where possible with allowed transitions between known electronic energy levels. The elements accessible by using four common dyes are tabulated. More than 20 elements are accessible within the wavelength range of each dye.

31643 **Microanalysis of reaction products in sealed tube wet air oxidations by capillary gas chromatography.** Conditt, M.K.; Sievers, R.E. (Univ. of Colorado, Boulder). *Analytical Chemistry;* **56**: No. 13, 2620-2622(Nov 1984).

Capillary gas chromatography can be used to analyze the reaction products of the oxidation of a compound in aqueous solution. A sealed glass capillary tube is used as the reaction vessel in which the compound and its products of oxidation are confined. The contents of the sealed tube are released upon crushing and are swept directly into the carrier gas stream of the gas chromatograph using a novel technique. As an example, the technique outlined in this paper is used to determine the combustion products of the wet air oxidation treatment of phenol; however, it may be used for any reaction in which volatile products are formed. A microanalysis technique is described which offers advantages over previously reported methods. The oxidation reaction at elevated pressure and temperature occurs in a sealed glass capillary tube and the reaction products are subsequently quantitatively introduced directly into a fused silica capillary column coated with a cross-linked polymer for gas chromatographic separation and analysis.

31644 **Characterization and comparison of vanadyl and nickel compounds in heavy crude petroleums and asphaltenes by reverse-phase and size-exclusion liquid chromatography/graphite furnace atomic absorption spectrometry.** Fish, R.H.; Komlenic, J.J.; Wines, B.K. (Univ. of California, Berkeley). *Analytical Chemistry;* **56**: No. 13, 2452-2460(Nov 1984). Contract AC03-76SF00098.

Vanadyl and nickel non-porphyrin rich fractions have been characterized in pyridine/water extracts of four heavy crude petroleums using reverse-phase high-performance liquid chromatography in combination with element-selective graphite furnace atomic absorption detection (RP-HPLC/GFAA). On the basis of rapid-scan UV-vis data indicating a lack of Soret absorbance associated with separated vanadyl and nickel containing fractions, we have categorized highly polar nickel compounds as non-porphyrin in Boscan, Cerro Negro, Wilmington, and Prudhoe Bay heavy crude petroleums. The presence of lower polarity vanadyl non-porphyrin compounds, occurring primarily in Wilmington and Prudhoe Bay petroleum, has also been confirmed. The vanadium histogrammic profiles, obtained using reverse-phase and size-exclusion HPLC/GFAA analysis for compounds extracted from the n-pentane (40:1) precipitated asphaltenes, were similar when compared to the pyridine/water extracts from the heavy crude petroleums.

31645 **Rapid and efficient capillary column supercritical fluid chromatography with mass spectrometric detection.** Smith, R.D.; Kalinoski, H.T.; Udseth, H.R.; Wright, B.W. (Pacific Northwest Lab., Richland, WA). *Analytical Chemistry;* **56**: No. 13, 2476-2480(Nov 1984). Contract AC06-76RL01830.

Capillary column supercritical fluid chromatography (SFC) using small diameter columns ($\sim$ 50 μm i.d.) has been demonstrated to provide efficient high-resolution separations. Microparticle packed column SFC has previously been demonstrated to allow very rapid moderate resolution separations, but the large pressure drop required by this approach does not allow effective pressure programming for fast separations to be obtained with capillary column SFC using high-pressure programming rates of up to 50 bar/min and provide advantages compared to packed column methods when the components to be separated span a wide molecular weight range. This approach complements the high-resolution capability of capillary SFC obtained using longer columns and provides increased sensitivity and narrow, nearly constant peak widths ($\leqq$ 6 s), which are ideally compatible with mass spectrometry (MS). Detection limits were found to be $\sim$ 0.1 pg for a series of biphenyl compounds using single ion monitoring. The application of capillary SFC/MS for both rapid and high-resolution separations is demonstrated for standard mixtures and a complex coal tar extract.

31646 **Development and preliminary evaluation of modified Savitzky-Golay smoothing functions.** Nevius, T.A.; Pardue, H.L. (Purdue Univ., West Lafayette, IN). *Analytical Chemistry;* **56**: No. 12, 2249-2251(Oct 1984). Contract AC02-79EV10240.

Modifications to the second-derivative terms of Savitzky-Golay digital filters are presented. The modified terms eliminate undesirable spectroscopic features. Neodymium solution and mercury pen light absorbance are examined using unmodified and modified digital filters. A significant reduction in high-frequency oscillatory behavior is found when using the modified function.

31647 **Spectrophotometric method for the determination of uranium in urine.** Kressin, I.K. (Los Alamos National Lab., NM). *Analytical Chemistry;* **56**: No. 12, 2269-2271(Oct 1984). Contract W-7405-ENG-36.

A method was developed in which 1 μg of uranium can be separated directly from 50 to 200 cm^3 of urine by anion exchange and then determined spectrophotometrically with arsenazo III.

31648 **Prediction of second and cross virial coefficients of blended mobile phases in gas chromatography.** Laub, R.J. (San Diego State Univ., CA). *Analytical Chemistry;* **56**: No. 12, 2110-2115(Oct 1984).

The second-interaction virial coefficients of vapors of potential interest as carriers in gas chromatography are considered in detail. Those examined include the monatomic gases helium, neon, argon, and krypton, the homonuclear diatomic compounds hydrogen, nitrogen, and oxygen, the heteronuclear inorganic species carbon monoxide, carbon dioxide, nitrous oxide, sulfur dioxide, water, hydrogen chloride, and ammonia, and the organic materials methane through n-pentane, carbon tetrachloride, and fluorotrichloromethane. Experimentally derived pure-component virial coefficients B/sub ii/ for all species except water and hydrogen chloride are shown to fit quadratic equations of the form (chosen so as to reflect the principle of corresponding states) B/sub ii//V/sub ii//sup c/ = f(T/sub ii//sup c//T), where the superscripts c indicate a critical value. The temperature range to which the temperature-invariant coefficients apply spans for all substances that for which accurate experimental data are available which, for many, is 200-950 K. Methods of prediction of the cross virial coefficient B/sub ii/ are detailed, and the results are then employed with B/sub ii/ for quantitative theoretical evaluation of the compositional variation of second-interaction virial coefficients B/sub M/.

31649 **Variation of gas chromatographic retentions with carrier pressure and composition.** Laub, R.J. (San Diego State Univ., CA). *Analytical Chemistry;* **56**: No. 12, 2115-2119(Oct 1984).

The second-interaction cross virial coefficients B/sub 1M/ are calculated for the solutes n-hexane, trans-3-hexene, benzene, 3,3-dimethylpentane, and cyclohexane with hydrogen, helium, nitrogen, carbon monoxide, carbon dioxide, argon, water, methane, ethane, carbon tetrachloride, and fluorotrichloromethane. The results are then used to evaluate the regression of In (solute specific retention volume) (V/sub g/π) with carrier pressure and composition, and it is shown theoretically as well as demonstrated experimentally that retentions as well as retention order can accordingly be altered. Plots of solute V/sub g/^{0} or of (V/sub g/π)$^{-1}$ against mole fraction of the fluoroalkane mobile phase in admixture with hydrogen are found to be curved, although the curvature is slight at column pressure drops of 1.1 atm and less. The linear variation of solute capacity factors K′ against partial pressure of steam + nitrogen as reported by Pretorius is thereby explained.

31650 **Secondary ion mass spectrometry of pyrene: enhancement of molecular ion emission by antimony trichloride.** Groenewold, G.S.; Todd, P.J.; Buchanan, M.V. (Oak Ridge National Lab., TN). *Analytical Chemistry;* **56**: No. 12, 2251-2253(Oct 1984). Contract AC05-84OR21400.

Antimony trichloride ($SbCl_3$) is used as a matrix to enhance the secondary emission of molecular pyrene ions. The behavior of the $SbCl_3$-pyrene system is investigated over the temperature range 21°C to 90°C. The results of the secondary ion mass spectrometric (SIMS) investigation are presented as a function of temperature. It is suggested that minor impurities in the $SbCl_3$ may aid in the oxidation of pyrene.

31651 **Nondestructive elemental analysis in three dimensions.** Borman, S.A. (Sandia National Labs., Albuquerque, NM). *Analytical Chemistry;* **56**: No. 1, 40(Jan 1984).

A new nuclear microprobe instrument for three-dimensional elemental analysis of solids has been developed. The instrument combines two techniques for three-dimensional analysis: Rutherford backscattering and elastic recoil detection. In the first case light ions impinge on heavy sample atoms and are scattered back to the detector. In the latter case heavy ions knock out light atoms that are then detected. The instrument is also equipped to perform proton induced x-ray analysis for trace element determinations.

31652 **Quantitative gas chromatography without analytic identification by ultrasonic detection.** Skogerboe, K.J.; Yeung, E.S. (Iowa State Univ., Ames). *Analytical Chemistry;* **56**: No. 14, 2684-2686(1984).

The response of the ultrasonic gas chromatographic detector is used to determine the absolute weight of an unknown analytic without a calibration curve. The method does not require that any physical properties of the analytic be known. The procedure for determining the weight concentration of an unknown requires that its response be measured in two carrier gases with different molecular weights but equal molar heat capacities, such as He and Kr. A detectability of 1 pg of hexane was found using He as the carrier gas.

31653 **Determination of pyrolyzable oxygen in ambient particulate matter.** Benner, W.H. (Lawrence Berkeley Lab., CA). *Analytical Chemistry;* **56**: No. 14, 2871-2875(1984). Contract AC03-76SF00098.

A technique is described for the determination of tens of micrograms of oxygen that can be pyrolyzed at T $<$ 1135°C. Standard oxygen-containing compounds and filter samples of ambient particulate matter are pyrolyzed in purified N_2, and oxygen in the pyrolysis products is quantitatively converted to CO by passage over carbon at 1135°C. The evolved CO is detected by NDIR (nondispersed infrared) spectrometry or by coulometry after conversion to CO_2. The application of the technique for the analysis of ambient particulate matter is shown.

31654 **Temperature-programmed evolved gas analysis for determining pyrolyzable oxygen.** Benner, W.H.; Hansen, A.D.A. (Univ. of California, Berkeley). *Analytical Chemistry;* **56**: No. 14, 2876-2879(1984). Contract AC03-76SF00098.

A temperature-programmed thermal analysis procedure is described for the characterization of oxygen in a sample. As a sample is pyrolyzed in N_2 to ~1100°C, oxygen in the gaseous decomposition products is converted to CO by passage over hot carbon. This CO is continuously measured with a NDIR (nondispersive infrared) detector. Recovery of oxygen in CO_2 and standard compounds was 100%. Thermograms of standard compounds, activated carbon, and ambient particulate matter show distinct features which demonstrate the potential applicability of this technique.

31655 **Aggregation and interactions of tributyl phosphate and tricaprylmethylammonium nitrate in hexane by osmometry.** Huang, C.H.; Bautista, R.G. (Iowa State Univ., Ames). *Separation Science and Technology;* **19**: No. 8-9, 515-529(1984). Contract W-7405-ENG-82.

The dimerization constant of tributyl phosphate in hexane has been determined by vapor pressure osmometry and was found to be in agreement with the values in the literature obtained by infrared spectroscopy. The tributyl phosphate-tricaprlymethylammonium nitrate extractants strongly associate with each other. The addition of varying concentrations of tricaprylmethylammonium nitrate to a constant concentration of tributyl phosphate results in a linear relationship of the average degree of aggregation of the mixture with the initial concentration of tricaprylmethylammonium nitrate. Varying the tributyl phosphate concentration results in a series of straight lines intersecting at one point. Extrapolation of the tributyl phosphate concentration to zero allows estimation of aggregation constants of tricaprylmethylammonium nitrate in hexane by the linear regression technique. 9 references, 5 figures, 6 tables.

4002 Inorganic And Physical Chemistry

REFER ALSO TO CITATION(S) 31569, 31591, 31648, 31649, 31650, 31670, 31672, 31677, 31694, 31714, 32532, 33007

31656 **(DOE/ER/13276—1) Characterization of catalysts with metal-support effects and of the species adsorbed on their surfaces. Progress report, September 1, 1984-August 30, 1985.** Vannice, M.A. (Pennsylvania State Univ., University Park (USA). Dept. of Chemical Engineering). 13 Jun 1985. Contract FG02-84ER13276. 13p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85012254.

During the past year we have succeeded in modifying our DSC-2C calorimeter to greatly enhance its sensitivity and stabilize the baseline behavior. The details of the changes required have been given in a recent publication. As a result we have extensively studied the influence of crystallite size and the support on heats of adsorption of H_2, CO, and O_2 on Pt and Pd. Isothermal, integral heats of adsorption have been measured for H_2 and CO adsorption on Pt and Pd dispersed on four supports, SiO_2, Al_2O_3, TiO_2 and SiO_2-Al_2O_3. These values were determined at 215K and 300 to 320K. Results are presented. For supported Pt the heats of adsorption were highest on Pt/SiO_2 and lowest on Pt/TiO_2. However, a clear trend existed between heats of adsorption and Pt exposed with large Pt crystallites having the highest values. The Pd catalysts exhibited behavior different than those for the Pt catalysts in two major aspects. First the heats of adsorption values tended to increase somewhat as crystallite sizes became very small. Second, the high temperature reduction step did not decrease the heats of adsorption values as significantly for Pd/TiO_2. 4 refs., 5 figs., 3 tabs.

31657 **(DOE/FE/60339—T14) Structure-sensitive catalytic dehydrogenation of hydrogen donors over iron sulfides: new methods for increasing coal depolymerization under mild conditions. Final report, July 1, 1983-December 31, 1984.** Smith, G.V.; Phillips, J.B. (Southern Illinois Univ., Carbondale (USA)). Mar 1985. Contract FC22-83FE60339. 31p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85011969.

The objectives of this project were to examine the mechanisms of hydrogen sulfides in order to explore the conditions for enhancement of in situ hydrogen sulfide production in coal and to study the conditions for stabilizing iron sulfide structures under reaction conditions. A special technical objective was to apply multiplex gas chromatography to the project. It was shown that iron sulfides dissociate hydrogen and that hydrogen sulfide formation from iron sulfides occurs by way of a Langmuir-Hinschelwood-type mechanism. Moreover, the dissociation of hydrogen was found to be exceptionally catalyzed under certain conditions, but the catalysis is transitory. This transient enhanced catalytic activity (TECA) occurs during surface reconstruction of troilite as sulfur is removed but before the exposed iron atoms migrate into the bulk. A special modulator was developed for analysis of small molecules by multiplex gas chromatography. 7 refs., 10 figs., 3 tabs.

31658 **(LBL—19459) Photoelectron spectroscopic study of bonding in inorganic and organometallic compounds.** Beach, D.B. (Lawrence Berkeley Lab., CA (USA)). May 1985. Contract AC03-76SF00098. 163p. NTIS, PC A08/MF A01; GPO Dep. File Number DE85011975.

Thesis.

The gas-phase x-ray photoelectron spectra of boron trihalides, silyl amines, and thiazyl fluorides were obtained. It was found that the order of pi stabilization in the boron trihalides is $BF_3 > BCl_3 \geqq BBr_3 > BI_3$. The nitrogen lone-pair orbitals of trisilylamine and tris(trimethyl)silylamine were about 1 eV more stable than a hypothetical nonbonded nitrogen lone pair, indicating N p pi → Si d pi bonding. Sulfur d orbital participation is needed to rationalize the corrected ionization potentials of NSF and NSF_3. The charge distributions and atomic orbital character of NSF and NSF_3 were obtained. The same technique was used to study sigma and pi interactions in borane adducts of CO and $CNCH_3$, iron tetracarbonyl olefin complexes, and transition metal complexes of isocyanides. Borane to carbon monoxide pi bonding is important in BH_3CO, and the increase in C–O and C–N bond strength observed when BH_3CO and BH_3CNCH_3 form borane adducts is due to rehybridization of the sigma orbitals on carbon. The equatorially coordinated ethylene ligand of $Fe(CO)_4C_2H_4$ is a better pi acceptor of electron density from the equatorial metal orbitals than the CO ligand it replaced, but a poorer pi acceptor to the Fe d/sub xz/, d/sub yz/ orbitals. By comparing the bonding of $CNCH_3$ to CO in $Fe(CO)_4CNCH_3$, it was shown that $CNCH_3$ is a weaker sigma donor and pi acceptor than CO in this complex, and that filled pi orbital interactions are relatively more important for $CNCH_3$ than for CO.

31659 **(ORNL/TM—9649) System for the continuous generation of phosphorous aerosols from Red Phosphorus-Butyl Rubber. Final report.** Holmberg, R.W.; Moneyhun, J.H.; Gayle, T.M. (Oak Ridge National Lab., TN (USA)). Jun 1985. Contract AC05-84OR21400. 39p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85013527.

A system for the continuous generation of phosphoric acid aerosols from burning Red Phosphorus-Butyl Rubber (RPBR) is described. The system is primarily intended for inhalation toxicology experiments using high aerosol concentrations (ca. 0.3 to 3 g/m^3), but is adaptable to other studies where a time independent concentration of the aerosol is desired in a flowing system. The RPBR formulation is softened by addition of a small amount of hexane and extruded at a controlled rate at high pressure through an orifice. A precision hydraulic extrusion system using a micrometer adjustable high pressure hydraulic pump has been developed to control the extrusion rate. The emerging filament is ignited and burned in a flowing air stream for delivery to chambers. In addition to the extrusion-combustion system for aerosol generation, devices for recovering the spent aerosol and for monitoring its concentration are described. 2 refs., 18 figs.

31660 **Single atom surface diffusion of sulfur on Ni(111).** Kellogg, G.L. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of Chemical Physics;* **83**: No. 2, 852-854(15 Jul 1985).

The surface diffusion of individual sulfur atoms on the Ni(111) plane has been investigated by field ion microscopy. The sulfur atoms were segregated to the surface by annealing the tip at

700 K. Surface diffusion on the (111) plane was detected at temperatures above 107 K with an activation energy of 0.29—0.30 eV. These results indicate a very high diffusion rate for sulfur on clean Ni(111) at typical reaction temperatures (e.g., 450—900 K for CO methanation).

31661 "Direct" calculation of quantum mechanical rate constants via path integral methods: Application to the reaction path Hamiltonian, with numerical test for the $H+H_2$ reaction in 3D. Yamashita, K.; Miller, W.H. (Department of Chemistry, University of California, and Materials and Molecular Research Division of the Lawrence Berkeley Laboratory, Berkeley, California 94720). *Journal of Chemical Physics;* **82**: No. 12, 5475-5484(15 Jun 1985).

The method recently proposed by Miller, Schwartz, and Tromp for determining Boltzmann rate constants "directly": by the path integral evaluation of a reactive flux correlation function: is developed within the framework of the reaction path Hamiltonian model for a general polyatomic reaction. The expression for the correlation function, the time integral of which is the rate constant, is reduced to a single path integral over only one degree of freedom (the reaction coordinate). Effects of tunneling, "frictional" effects on the reaction coordinate due to coupling to other degrees of freedom, and the effects of recrossing the transition state dividing surface are all correctly accounted for in the approach. Numerical tests of the formulas for the 3D version of the $H+H_2$ reaction (on the Porter—Karplus potential surface) gives excellent agreement with the (known) accurate results for this system.

31662 Kinetics of the reactions of NCO radicals with H_2 and NO using laser photolysis—laser induced fluorescence. Perry, R.A. (Combustion Research Facility, Sandia National Laboratories, Livermore, California 94550). *Journal of Chemical Physics;* **82**: No. 12, 5485-5488(15 Jun 1985).

Absolute rate constants for the reaction of NCO radicals with hydrogen (k_6; T = 592—913K) and nitric oxide (k_7;T = 294—538K) were measured using excimer laser photolysis-laser induced fluorescence at 416.8 nm. The following Arrhenius expressions summarize the data: $k_6 = 1.43 \times 10^{-11}$e/sup() -9000plus-or-minus1500/R/T $k_7 = 1.69 \times 10^{-11}$e/sup() 390plus-or-minus320/R/T cm^3 $molecule^{-1}$ s^{-1}. The experimental technique and results are discussed, and the importance of these reactions to combustion chemistry is addressed.

31663 Molecular dynamics study of the reaction H_2/OH→H_2O+H. Rashed, O.; Brown, N.J. (Applied Science Division, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Journal of Chemical Physics;* **82**: No. 12, 5506-5518(15 Jun 1985).

Classical trajectory calculations have been performed to determine the influence of translational temperature, H_2 vibrational energy, H_2 rotational energy, OH vibrational energy, and OH rotational energy on the reaction $H_2+OH \rightarrow H_2O+H$. The potential energy surface was a modification of the Schatz—Elgersma analytical fit to the Walsh—Dunning surface. Reactivity increases with translational temperature, and is most strongly influenced by it. Rotational excitation of either or both molecules suppresses reactivity. Vibrational excitation of H_2 enhances reactivity, and vibrational excitation of OH has no effect. A thermal rate coefficient was computed for the reaction at 1200 and 2000 K. The computed value compares favorably with the experiment at 2000 K, while the agreement at 1200 K is less satisfactory. The agreement between theory and experiment at both temperatures indicates that the potential surface is a reasonable representation of the HHOH potential energy surface.

31664 Dynamics of atomic hydrogen and deuterium recombination on the stepped Pt(557) crystal surface. Lin, T.H.; Somorjai, G.A. (Univ. of California, Berkeley). *Journal of Physical Chemistry;* **89**: No. 1, 135-139(3 Jan 1985). Contract AC03-76SF00098.

The velocity distribution of HD produced on the Pt(557) crystal surface from atomic hydrogen and deuterium incident beams is measured in the temperature range of 150-700 K. The striking results are that (1) the average kinetic energy of the desorbing HD increases as the crystal temperature decreases from 300 to 200 K; (2) at 200 K, the velocity distribution is considerably wider than the Maxwellian distribution and there is a significant amount of HD leaving the surface with translational energy corresponding to 1900 K; (3) for a fraction of the incident atoms, the residence time decreases as the crystal temperature decreases from 300 to 200 K. It appears that some of the incident atoms can react with chemisorbed atoms at high coverage before they achieve thermal equilibrium with the surface. 21 references, 5 figures.

31665 Structure of potassium tetrakis(isothiocyanato)cobaltate(II) monohydrate nitromethane solvate, $K_2[Co(NCS)_4].H_2O.2CH_3NO_2$, at 120 K by neutron diffraction. Wood, J.S. (Massachusetts Univ., Amherst (USA)); McMullan, R.K. (Brookhaven National Lab., Upton, NY (USA)). *Acta Crystallographica, Section C: Crystal Structure Communications;* **40**: No. 11, 1803-1806(15 Nov 1984).

Msub(r) = 509.6, monoclinic, I2 (conventional C2), a = 11.098 (2), b = 5.227 (1), c = 16.496 (3) A, β = 100.06 (1)°, V = 942.2 (3) A^3, Z = 2, Dsub(x) = 1.796, Dsub(m) = 1.78 g cm^{-3}, lambda = 1.0470 (1) A, μ = 0.771 cm^{-1}, T = 120 K. Final $R(F^2)$ = 0.038 for 2011 observed reflections. The structure is built from chains of approximately tetrahedral $[Co(NCS)_4]^{2-}$ anions parallel to b and interconnected by O-H...S hydrogen bonds of length 3.377 (2) A. The potassium ions are linked by the nitromethane and water molecules to give double chains also parallel to b. Average bond distances in the anion are Co-N 1.964 (2), N-C 1.173 (1) and C-S 1.627 (2) A.

31666 Method for removing oxide contamination from silicon carbide powders. Brynestad, J.; Bamberger, C.E. (to Dept. of Energy). US Patent Application 6-636,658. 1 Aug 1984. 10p. Contract AC05-84OR21400.

The described invention is directed to a method for removing oxide contamination in the form of oxygen-containing compounds such as SiO_2 and B_2O_3 from a charge of finely divided silicon carbide. The silicon carbide charge is contacted with a stream of hydrogen fluoride mixed with an inert gas carrier such as argon at a temperature in the range of about 200° to 650°C. The oxides in the charge react with the heated hydrogen fluoride to form volatile gaseous fluorides such as SiF_4 and BF_3 which pass through the charge along with unreacted hydrogen fluoride and the carrier gas. Any residual gaseous reaction products and hydrogen fluoride remaining in the charge are removed by contacting the charge with the stream of inert gas which also cools the powder to room temperature. The removal of the oxygen contamination by practicing the present method provides silicon carbide powders with desirable pressing and sintering characteristics. 1 tab.

31667 (UCRL-Trans—12059) Graphite insertion compounds. Part III. Translated from *Bulletin de la Societe Chimique de France ;* No. 7-8, 1010-1011(Jul-Aug 1955). Contract W-7405-ENG-48. 6p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85011801. DE85011801

Even though new insertion compounds of graphite are still being discovered, their number remains limited. These compounds can be classified as reversible or irreversible. The stability of insertion decreases from Cs to Na, and Li yields compounds that are different from those of the other alkali metals. It is shown that reversible insertion is due to metallic-type bonds and irreversible insertion to ionic-type bonds. Other metals than the alkali metals do not bond to graphite because their atomic radii are too small. (DLC)

4003 Organic Chemistry

REFER ALSO TO CITATION(S) 29635, 29636, 29656, 29658, 29840, 29895, 30065, 30068, 31595, 31643, 31648, 31649, 31650, 31655, 31658, 31665, 31686, 31694, 31720

31668 (BARC—1217) Synthesis of 2,2'-p-phenylene-bis-5-p-alkylphenyl oxazoles. Dhane, D.L.; Noras, K.A.; Mushrif, A.U. (Bhabha Atomic Research Centre, Bombay (India). Chemical Engineering Div.). 1984. 15p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85900983.

A convenient method has been described for the synthesis of 2, 2′-p-phenylene-bis-5-p-alkylphenyl oxazoles. This involves firstly the condensation of glycine with terepthaloyl chloride formed by the action of phosphorus pentachloride on terephthalic acid to give terephthaloyl diglycine which was then converted to its chloride. Terephtholyldiglycyl chloride was then used as an acylating agent in its reaction with ethylbenzene, toluene and benzene to give N,N′-substituted diamides which on dehydration gave 2,2′-p-phenylene-bis-5-p-alkylphenyl oxazole. One of the oxazoles viz 2,2′-p-phenylene-bis-5-pethylphenyl oxazole is hitherto unreported. Its nmr, ir and fluorescence spectrum have been recorded. 9 refs., 4 figs., 2 tabs.

31669 **(DOE/ER/10982—4) Prediction of thermodynamic properties of coal derivatives. Progress report, September 1, 1984-August 31, 1985.** Donohue, M.D. (Johns Hopkins Univ., Baltimore, MD (USA)). May 1985. Contract AC02-81ER10982. 24p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85013147.

In this report, the progress of our efforts toward understanding mole. Tular behavior and its effect on thermodynamic properties is presented. An equation of state, the Perturbed-Anisotropic-Chain Theory (PACT), has been developed to treat fluids and fluid mixtures with various intermolecular interactions. These include Lennard-Jones interactions, anisotropic forces for dipolar and quadrupolar molecules, and hydrogen bonding interactions. Experiments also were performed for binary and ternary mixtures containing carbon dioxide and heavy aromatics. Our progress, both theoretical and experimental, is presented below in the following order: (1) prediction of properties for polymeric systems using PACT; (2) extension of PACT to treat hydrogen bonding systems for two cases: (a) pure-components and (b) binary mixtures of a hydrogen bonding molecule with an inert solvent (diluent); (3) reformulation of PACT to account for group-group interactions when several functional groups are present in one molecule; (4) simplification of the Perturbed-Hard-Chain Theory (PHCT) by replacing the cumbersome attractive term with an expression derived from the local composition model; and (5) experimental measurements for binary mixtures of carbon dioxide and heavy aromatics as well as enhancement of solubility of heavy aromatics in carbon dioxide by addition of a third component. 7 refs., 8 figs., 2 tabs.

31670 **(DOE/ER/10982—5) Thermodynamics of multipolar molecules: the perturbed-anisotropic-chain theory.** Vimalchand, P.; Donohue, M.D.; Celmins, I.C. (Johns Hopkins Univ., Baltimore, MD (USA). Dept. of Chemical Engineering). 1985. Contract AC02-81ER10982. 43p. (CONF-850417—22). NTIS, PC A03/MF A01; GPO Dep. File Number DE85013148.

From 189. national meeting of the American Chemical Society; Miami, FL, USA (28 Apr 1985).

The Perturbed-Hard-Chain theory (PHCT) is modified to treat rigorously dipolar and quadrupolar fluids and their mixtures. The multi-polar interactions, which are treated explicitly, are calculated by extending the perturbation expansion of Gubbins and Twu to chain molecules. Moreover, the square-well potential used to characterize the spherically symmetric interactions in the PHCT has been replaced by a soft-core (Leonard-Jones) potential. Theoretical claculations and data reduction on a number of pure fluids and mixtures indicate that the above changes result in physically more meaningful pure component parameters, and the properties of even highly non-ideal mixtures can be predicted accurately without the use of a binary interaction parameter. 18 refs, 14 figs., 3 tabs.

31671 **(DOE/RL/01830—T35) Separation of gas mixtures by supported complexes.** (Pacific Northwest Labs., Richland, WA (USA)). [1985]. Contract AC06-76RL01830. 8p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85011996.

The objective of this program is to define the most advantageous materials (both complex and support), methods of material preparation, material properties, and the performance of feasible supported complex systems in applicable gas separations. 12 refs., 2 figs., 3 tabs.

31672 **(INIS-mf—9458) Performance of rare earth modified faujasites in the process of toluene disproportionation.** Azzouz, A.; Fourar, M.; Berrak, A. (Commissariat aux Energies Nouvelles, Algiers (Algeria). Centre de Developpement de Materiaux). Jun 1984. 8p. (In French). NTIS (US Sales Only), PC A02/MF A01. File Number DE85701028.

The purpose of the present paper is the study of the performances of some catalysts based on y-type faujasite exchanged with La (3+) and Ce (3+) cations in the process of toluene disproportionation to benzene and xylenes. In the first stage the crystallographic study by the X-rays diffraction method shows that the cation exchange causes 311 plane displacements in the zeolite structure, accompanied by a decrease of diffraction limit intensity. Further the faujasite pretreatment with NH4 (4+) ions plays some role in the protection of the crystallinity. Moreover the cation exchange seems to take an optimum value around 73% for which the toluene conversion is maximum. This phenomenon is probably due to a decrease of the internal free volume for a pronounced cation exchange. The best performances are obtained by the zeolite that has undergone a slow and programmed thermal activation after cation exchange. This is probably due to the slowness of ion rearrangement phenomena, and of the catalytic surface restructuration. In the second stage the realization of toluene disproportionation process shows that the cation exchange with such elements confers to the faujasite an appreciable catalytic activity in the temperature range of 350-500 degC. The catalysts obtained permit about 20-60% toluene conversions. The catalytic activity is slightly higher in La-modified samples, whereas those containing Ce (3+) present relatively a better selectivity to the main process. Nevertheless, both types of catalysts show approximately a similar behaviour, favoring the p-xylene formation. The proportion of the latter exceeds that of thermodynamic equilibrium at temperatures less than 430 degC. The temperature increase affects this selectivity. This is probably due to dehydration phenomenon which are frequent around this value.

31673 **(IS-T—1144) Mechanistic study of the hydrodesulfurization of methanethiol over tungsten disulfide; a survey of rare earth sulfides for hydrodesulfurization activity.** Dowd, D.Q. (Ames Lab., IA (USA)). Jun 1985. Contract W-7405-ENG-82. 117p. NTIS, PC A06/MF A01; GPO Dep. File Number DE85011758.

Thesis.

Hydrodesulfurization is a process whereby sulfur bound in organic compounds is removed as hydrogen sulfide, and is important to the control of sulfur dioxide emissions in the combustion of petroleum and coal fuels. It involves the cleavage of carbon sulfur bonds, and is catalyzed by layered disulfides such as molybdenum and tungsten disulfide. The simplest example is the reaction $CH_3SH + H_2 \rightarrow CH_4 + H_2S$. The mechanism of even this protypical reaction is unclear. In an effort to clarify it, the kinetics of methanethiol hydrodesulfurization over tungsten disulfide at low pressures was established, with partial pressures of methanethiol and hydrogen varied over a hundred fold. The kinetic order in each reactant was positive when its partial pressure was low negative when its partial pressure was high. The negative order in hydrogen had not been previously seen. The product gases, methane and hydrogen sulfide, each exhibited negative kinetic orders at high partial pressures, zero kinetic orders at low partial pressures. A dual site Langmuir-Hinshelwood type mechanism, which defines one active site as two adjacent edge sulfur vacancies and the second as a neighboring sulfur atom, describes these results quite well. Seventeen rare earth sulfides were surveyed for catalytic activity toward methanethiol hydrodesulfurization. These sulfides included both stoichiometric and nonstoichiometric compositions and four different morphologies. In general, nonconductors were inactive and conductors were active. This correlation extended to the nonstoichiometric γ-phase sesquisulfides which exhibit both insulating and conducting properties. 96 refs.

31674 **(IS-T—1180) Formation of benzene by the pyrolysis of 4-vinylcyclohexene regiospecific formation of anthracenes in the pyrolysis of dibenzobuerones and related systems.** Tunkel, J.L. (Ames Lab., IA (USA)). Mar 1985. Contract W-7405-ENG-82. 211p. NTIS, PC A10/MF A01; GPO Dep. File Number DE85009225.

Thesis.

The thermal rearrangement of the dimer of butadient, 4-vinyl-cyclohexene, was investigated by flash vacuum pyrolysis (FVP). The FVP of 4-vinylcyclohexene-3,3,5,5,6,6,8,8-d_8 at 800°C gave benzene, which had a statistical deuterium incorporation, as a major product. From the results of the study, a new mechanism for the pathway from butadiene to benzene is proposed. Also described is a study on dibenzocyclooctene-5,5,6,6-d_4 and the isolation and characterization of the minor products produced along with anthracene in the FVP of 16. The FVP of 2,9-dimethyldibenzosuberone gives, as the sole product, 2,6-dimethylanthracene. The regiospecific transformation arises from a 180° ring flip of the two original aromatic nuclei relative to one another. The synthetic utility of this reaction was investigated, and it is a high yield, regiospecific route to difunctionalized anthracenes.

31675 (LBL—19444) **Transition-metal mediated formation and cleavage of carbon-hydrogen bonds: hydrogenolysis of trinuclear alkylidyne clusters and oxidative addition of carbon-hydrogen bonds to rhenium.** Seidler, P.F. (Lawrence Berkeley Lab., CA (USA)). Mar 1985. Contract AC03-76SF00098. 191p. NTIS, PC A09/MF A01; GPO Dep. File Number DE85012231.

Thesis.

Treatment of dicobalt alkyne complexes $Co_2(CO)_6(HCCR)$ (R = alkyl, aryl) with H_2 and $Co_2(CO)_8$ or $CpMo(CO)_3H$ leads to μ_3-alkylidyne complexes with molecular formula $Co_3(CO)_9CCH_2R$ and $CpMo(CO)_2Co_2(CO)_6CCH_2R$, respectively, in high yield and purity. Hydrogenation of these clusters occurs under mild conditions (60 to 90 °C, benzene solution, 3 to 4 atm of H_2) and gives olefins, paraffins, and carbonyl compounds. A radical pathway for the hydrogenolyses is suggested. ESR experiments involving the reaction of $Co_3(CO)_9CCH_2(CH_3)_3$ (2) with H_2 in the presence of the spin-trap t-BuNO confirm the intervention of vinyl radical intermediates and reveal that a hydrogen atom donor is generated. Evidence consistent with vinyl radical intermediates is also provided by isotope labelling. Inter- and intramolecular C-H oxidative addition reactions have been observed from two related organorhenium intermediates: $Cp^*Re(CO)(PMe_3)$ (11) and $Cp^*Re(PMe_3)_2c$ (12) (Cp^* = eta^5-$C_5(CH_3)_5$). The cyclometallated compounds undergo reductive elimination; the coordinatively unsaturated species thus formed can be trapped to give intermolecular C-H activation products under mild thermal conditions. In contrast to its (carbonyl)phosphine analog 11, 12 is capable of insertion into the C-H bonds of methane as well as cyclopropane and benzene. 100 refs., 20 figs., 1 tab.

31676 (ZfI-Mitt—77, pp 92-97) **^{15}N-amino acids syntheses.** Engelmann, H.; Dauert, A.; Niclas, H.; Lueneberger, H. (VEB Berlin-Chemie (German Democratic Republic)). Sep 1983. (In German). NTIS (US Sales Only), PC A14/MF A01. File Number DE85780083. (CONF-8305218—Summ.).

From Recent results of /sup 15/N tracer technique in medicine symposium; Rostock, German D.R. (29 May 1983).

4 syntheses of ^{15}N-amino acids are presented: (1) ammonolysis of α-halogenated acids with $H^{15}NO_3$, (2) hydrolysis of hydantoin derivatives using $^{15}NH_4HCO_3$, (3) synthesis with phthalimide-^{15}N potassium and (4) synthesis with acetamino-^{15}N diethyl malonate.

31677 **Neutron diffraction study of lithium hydrogen phthalate monohydrate: A material with two very short intramolecular OxxxHxxxO hydrogen bonds.** Kueppers, H.; Takusagawa, F.; Koetzle, T.F. (Mineralogisches Institut der Universitaet Kiel, Olshausenstrasse 40-60, D-2300 Kiel, Federal Republic of Germany). *Journal of Chemical Physics;* **82**: No. 12, 5636-5647(15 Jun 1985). Contract AC02-76CH00016.

The structure of lithium hydrogen phthalate monohydrate has been refined based upon neutron diffraction data obtained at three temperatures: 15, 100, and 298 K. All bond distances have been determined with precision better than 0.002 A. The two crystallographically independent hydrogen phthalate anions in the unit cell both possess very short intramolecular OxxxHxxxO hydrogen bonds with OxxxOroughly-equal2.4 A and angleOxxxHxxxOroughly-equal170°. One of these linkages is very decidedly asymmetric, with OxxxH = 1.122(1) A and HxxxO = 1.294(1) A at 15 K, reflecting the fact that the two O atoms have quite different environments in the crystal. The second OxxxHxxxO bond is more nearly symmetric, with OxxxH = 1.195(1) A and HxxxO = 1.205(1) A at 15 K, but the difference between the two distances is still significant. The asymmetry of the short hydrogen bonds appears somewhat more pronounced at 298 K than at the lower temperatures. A corresponding shift with temperature of the H atom in the short intramolecular hydrogen bond was found previously in 2,3-pyridinedicarboxylic acid, which has a molecular geometry similar to that found here.

31678 **Rotational reorientation dynamics at high pressures: rhodamine 6G in ethanol from 1 bar to 6 kbar.** Philips, L.A.; Webb, S.P.; Yeh, S.W.; Clark, J.H. (Univ. of California, Berkeley). *Journal of Physical Chemistry;* **89**: No. 1, 17-19(3 Jan 1985).

Picosecond, time-resolved fluorescence depolarization spectroscopy has been used to measure the rotational reorientation time (tau/sub or/) of electronically excited rhodamine 6G. When the dependence of tau/sub or/ on solvent viscosity for a series of linear alcohols is compared with that for ethanol as a function of pressure over the range from 1 bar to 6 kbar, substantially different rotational reorientation dynamics are found for identical macroscopic viscosities. 31 references, 2 figures, 2 tables.

31679 **Infrared multiphoton dissociation of octafluorocyclobutane with a two-frequency Q-switched CO_2 laser.** Pochon, E.; Weston, R.E. Jr.; Flynn, G.W. (Brookhaven National Lab., Upton, NY). *Journal of Physical Chemistry;* **89**: No. 1, 86-94(3 Jan 1985). Contract AC02-76CH00016;AC02-78ER04940.

The infrared multiphoton dissociation of octafluorocyclobutane has been investigated by the use of two CO_2 laser pulses of different frequency, synchronized by the same Q-switching mirror. The dissociation yield has been determined as a function of laser pulse energy, frequency of the dissociating pulse, substrate pressure, and interpulse delay. Accompanying transport phenomena (expansion and diffusion) were taken into account by the use of appropriate models. The kinetic behavior of highly vibrationally excited c-C_4F_8 molecules indicates that collisional relaxation occurs at nearly gas kinetic rates. 47 references, 10 figures.

31680 **Synthesis of aryl halides via organoborane chemistry.** Kabalka, G.W.; Sastry, K.A.R.; Sastry, U.; Somayaji, V. (Univ. of Tennessee, Knoxville). *Org Prep Proc Int;* **14**: 359-362(1982).

A method for the rapid synthesis of a variety of substituted aryl halides by the reaction of organoboranes with halide ions in the presence of chloramine-T is described in detail. The products were purified by column chromatography on silica gel using a mixture of petroleum ether-ethyl acetate as eluent.

4004 Electrochemistry

REFER ALSO TO CITATION(S) 30678, 31522

31681 (CONF-840677—Summs., pp 230) **Development of multicomponent transport theory and transport data for membranes in concentrated electrolytes.** Ruggeri, R.T.; Beck, T.R. (Electrochemical Technology Corp., Seattle, WA). Jun 1984. NTIS, PC A11/MF A01. File Number DE84013679.

From 6. DOE battery and electrochemical contractors' conference; Washington, DC, USA (25 Jun 1984).

31682 (DOE/ER/13247—1) **[Chemical probes of charge transfer at semiconductor/liquid junctions]. Technical report for May 15, 1984-January 15, 1985.** Koval, C.A. (Colorado Univ., Boulder (USA)). 1985. Contract FG02-84ER13247. 3p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85013082.

A study of the effects of surface energetics and surface oxide layers on the cyclic voltametry of metallocenes at nonilluminated p- and n-InP electrodes has been completed. Nearly ideal semiconductor/solution interfaces can be prepared, it was concluded, and the voltammetry of metallocenes is a way to probe electron transfer across this interface under different surface energetic conditions. Single crystals of WSe_2 were grown by chemical vapor transport. A computer program was written to collect voltametric data and calculated convoluted currents, and it is used to examine the kinetics of charge transfer across the semiconductor solution interface. (LEW)

31683 **(LBL—19146) Experimental evaluation of the thermodynamic properties of concentrated aqueous potassium hyroxide solutions. Final report.** Johnson, W.B.; St. Pierre, G.R.; Macdonald, D.D.; Malhotra, M.K. (Ohio State Univ., Columbus (USA). Dept. of Metallurgical Engineering). Feb 1985. Contract AC03-76SF00098. 70p. NTIS, PC A04/MF A01; GPO Dep. File Number DE85010628.

The thermodynamic activity of water in a binary KOH H_2O system has been measured using an electrochemical cell, Cell A [H_2(Pt)/KOH in H_2O/Hg, HgO(Pt)], in the concentration range between 1 and 8 molal and the temperature range of 0 to 80°C. From the equilibrium voltage of cell (A), the activity of water can be directly calculated without making assumptions about the degree of dissociation of the solute or any other solution parameters. The measured values of activity are greater than those found in previous vapor pressure studies, but are consistent with previous EMF measurements of KOH concentration cells at 25°C. These values are invariant with temperature for concentrations up to 4.0 molal but between 6.0 and 8.0 molal the H_2O activity first decreases by approximately 10% and then increases by ~ 15% as the temperature is increased. The general activity trend is consistent with, though smaller than, the results in the higher concentration ranges of the previous vapor pressure studies. The values of activity of water reported here can be used to refine previous calculations of Macdonald and coworkers (see LBL Final Report 4505110) on the theoretical efficiencies of alkaline battery systems. Since the measured activity values of water are within ~ 10% of those used in the previous calculations, the major conclusions of that study are not significantly affected.

31684 **Ion chemistry in silane dc discharges.** Chatham, H.; Gallagher, A. (Joint Institute for Laboratory Astrophysics, University of Colorado and National Bureau of Standards, Boulder, Colorado 80309). *Journal of Applied Physics;* **58**: No. 1, 159-169(1 Jul 1985).

The ion production and reactions in dc silane discharges are calculated. It is noted that almost all ion production and reaction occur in the cathode sheath region for typical low-pressure silicon-deposition discharges, so that the calculation considers ion production, drift, and reactions in the sheath region. Sheath models, for inert gas discharges, that utilize local and nonlocal electron energy distributions are compared, and one is adapted to silane conditions. The distribution of ion species (Si/sub l/H^+/sub m/) arriving at the cathode is calculated for a range of discharge pressures and currents, for comparison to mass spectrometer measurements. However, we do not make quantitative comparisons to reported observations due to sampling-bias issues that have not been taken into account.

4005 Photochemistry

REFER ALSO TO CITATION(S) 30057, 30299, 30326, 31679, 32139

31685 **(CBPF-NF—009/83) Photofragmentation of $Fe(CO)_5$. 1. Infrared and Moessbauer evidence for the formation of $Fe(CO)_4$ in polymer matrices.** De Paoli, M.A.; Oliveira, S.M. de; Saitovitch, E.M.B.; Guenzburger, D.J.R. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1983. 19p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85701417.

Pentacarbonyliron sorbed in low density polyethylene (LDPE) or polytetrafluorethylene (PTFE) and irradiated with ultraviolet light has been studied by infrared and Moessbauer spectroscopies. The main photofragment reacts with the residual pentacarbonyliron leading to the formation of $Fe_2(CO)_9$. This reaction, plus the information obtained from infrared and Moessbauer spectra, suggest that the new species could be assigned as tetracarbonyliron, $Fe(CO)_4$, and tricarbonyliron $Fe(CO)_3$. It is proved that molecules sorbed in a polymer matrix can be used as Moessbauer absorbers at low temperature. The polymer matrix allowed the isolation of otherwise unstable species: the high permeability of LDPE to gaseous carbon monoxide precludes the reformation of pentacarbonyliron molecules, thus excluding the 'cage effect' observed in frozen gas matrices.

31686 **(DOE/ER/10424—4) Electron photoejection in carbanions. Final report.** Tolbert, L.M. (Kentucky Univ., Lexington (USA). Dept. of Chemistry). 1984. Contract AS05-79ER10424. 20p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85011748.

We have been investigating the photochemistry of resonance-stabilized carbanions. Photoexcited carbanions are very strong reductants, and such electron-transfer photosensitizers might find utility as models and, eventually, agents, for solar energy conversion devices. Our initial work has concentrated on evaluating the factors which control carbanion photochemistry and select among the various decay pathways such as isomerization or electron ejection. A ground state carbanion has a specific and well-defined space-charge relationship such that the negative charge is not evenly distributed, but rather is localized at certain atoms in the molecule. In the excited state, a new space-charge relationship exists, and the charge is redistributed to other atoms. It is this phenomenon which we believe dominates the photochemistry of such species and which provides a framework for this report of our work on carbanion photoreactivity. 22 refs.

31687 **(DOE/ER/10457—4-Rev.) Solar energy conversion in homogeneous solution. Final report, August 1, 1979-November 30, 1984. Revision.** Richman, R.M. (Carnegie-Mellon Univ., Pittsburgh, PA (USA). Dept. of Chemistry). 1984. Contract AC02-79ER10457. 5p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85006883.

Several compounds of the form M-X-M, where M is a transition metal complex and X is a single atom bridge (O, N, or C) have been studied photochemically. The objective was the generation of high-energy species from radiation in the solar spectrum. $(FeTPP)_2O$, $(FeTPPC)_2O$, $(FeTPP)_2N$, and $(FeTPP)_2C$ photodisproportinate in solution to yield interesting high-oxidation state species, as demonstrated in continuous and flash photolysis studies. FeOTPP converts cyclohexene to 2-cyclohexene-1-one. FeOTPPC oxidizes amines in aqueous solution. FeNTPP is relatively unreactive, while FeCTPP reacts indistriminantly in all solvents tested. $[Ru(NH_3)_5]_2O^{4+}$ undergoes photosubstitution, with a solvent molecule replacing an ammonia ligand. These unsymmetrical products decompose to Ru(III) monomers. The results demonstrate that photodisproportionation is a significant new strategy for solar energy conversion. 7 refs.

31688 **(DOE/ER/13023—T1) Investigations on multiphoton ionization and laser-ion beam photodissociation spectroscopy. Progress report, September 1, 1982-August 31, 1985.** Russell, D.H. (Texas A and M Univ., College Station (USA). Dept. of Chemistry). 1985. Contract AS05-82ER13023. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85009696.

The laser-ion beam photodissociation (LIBP) experiment is performed by intersecting a beam of ions with a high intensity laser beam and mass-analyzing the photofragment ions formed by dissociation of the photo-excited ions produced by absorption of a photon. Since the photo-excited ion is formed by a resonance photon absorption process, this experiment can be used to obtain information on the electronic structure of the ion, to study the occurrence of isomerization/rearrangement reactions of the gas phase ion, and the dynamics of unimolecular dissociation reactions. 6 refs., 2 figs.

31689 **P-aminobenzoic acid can sensitize the formation of pyrimidine dimers in DNA: direct chemical evidence.** Sutherland, J.C.; Griffin, K.P. (Brookhaven National Lab., Upton, NY (USA)). *Photochemistry and Photobiology;* **40**: No. 3, 391-394(Sep 1984).

Thymine-containing photoproducts with chromatographic properties similar to those of cyclobutyl pyrimidine dimers can be formed in [^{3}H]-thymine-labeled DNA in solution by 313 nm ultraviolet radiation in the presence of para-aminobenzoic acid (PABA), a compound used in sunscreen preparations. In the absence of PABA, similar fluences of 313 nm radiation do not produce significant numbers of these photoproducts. The thymine-containing photoproducts can be reversed by 254 nm radiation so that the tritium label migrates with the mobility of thymine monomer, a behavior characteristic of thymine-containing cyclobutyl pyrimidine dimers. This result supports previous, but less direct, data from other laboratories indicating that PABA can sensitize dimer formation in the DNA of bacterial and mammalian cells.

4006 Radiation Chemistry

REFER ALSO TO CITATION(S) 29923, 30670, 31540

31690 (IA—1404, pp 144) **Ligand metal interrelationships Part II. The effect of the change from square planar to octahedral coordination on the pKa of the ligand in unsaturated tetraaza-macrocyclic nickel complexes. A pulse radiolytic study.** Cohen, H.; Meyerstein, D. (Israel Atomic Energy Commission, Tel Aviv); Nutkovich, M.; Shusterman, A. (Ben-Gurion Univ. of the Negev, Beersheba (Israel)). Jul 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85780940.

Published in summary form only.
In Research laboratories annual report 1983.

31691 (IA—1404, pp 150-151) **Photo-induced cleavage of water with radiolytically prepared colloidal platinum catalysts.** Baruch, G.; Haruvy, Y.; Rajbenbach, L.A.; Rafaeloff, R. Jul 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85780940.

Published in summary form only.
In Research laboratories annual report 1983.

31692 (IA—1404, pp 151) **Photo-induced cleavage of water with radiolytically prepared heterogeneous platinum catalysts.** Baruch, G.; Haruvi, Y.; Rajbenbach, L.A.; Rafaeloff, R. Jul 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85780940.

Published in summary form only.
In Research laboratories annual report 1983.

31693 (NUREG/CR—3514-Vol.2) **Chemical behavior of iodine in aqueous solutions up to 150°C. II. Radiation-redox conditions.** Toth, L.M.; Dodson, K.E. (Oak Ridge National Lab., TN (USA)). Mar 1985. Contract AC05-84OR21400. 22p. (ORNL/TM—8664/V2). NTIS, PC A02/MF A01 - GPO. File Number TI85010139.

Redox reactions that might alter the volatility of aqueous iodine solutions have been examined experimentally using absorption spectrophotometry. Oxygen and hydrogen atmospheres had no effect on the iodine chemistry at temperatures up to 150°C. However, irradiation of aqueous solutions with a ^{60}Co source, 0.8 x 10^6 R/h, produced radiolysis products that either oxidized iodide ion or reduced IO_3^- in the pH range 6 to 9 and generated significant amounts of volatile iodine. The amount of iodine volatilized varied from a few percent for solute concentrations of 10^{-4} M to as much as 10 to 19% for 10^{-6} M CsI or KIO_3 solutes. Silver metal has been shown to provide an effective gettering route for I^- in solution if these ions are first oxidized by .OH radicals generated during the radiolysis of the solutions.

31694 **Ionization of the hydroxycyclohexadienyl radical in concentrated KOH: a measure of the activity of OH^- in highly basic media.** Taniguchi, H.; Schuler, R.H. (Univ. of Notre Dame, IN). *Journal of Physical Chemistry;* **89**: No. 2, 335-338(17 Jan 1985).

The ESR spectrum of the hydroxycyclohexadienyl radical has been examined in aqueous solutions containing up to 10 M KOH. In strongly basic solution the radical exists, as a result of ionization of the OH proton, predominantly in an anionic form where the hyperfine constant of the C_6 proton ($a(H_6)$) is ~ 4 G greater than that of the neutral radical. The other ESR parameters are virtually unaffected by ionization. At pH values above 12, equilibration of the neutral and anionic forms is rapid. From the dependence observed up to 1 M OH^-, the pK/sub b/ deprotonation of this radical by the base is found to be -0.58 +/- 0.05. At higher base concentrations, $a(H_6)$ provides a good measure of the apparent activity of OH^-. While the present measurements indicate that the activity coefficient of OH^- in strong bases considerably exceeds one, the values obtained are substantially less than those given by the spectrophotometric measurements of Yagil using indoles as indicators. Implications of the differences noted on the significances of any given basicity scale are discussed. 13 references, 3 figures, 1 table.

4007 Radiochemistry And Nuclear Chemistry

REFER ALSO TO CITATION(S) 29890, 29891, 29923, 29944, 29945, 29979, 31592, 31595

31695 (CSIR-TSD—0009/83, pp 14) **Production of radio-isotopes.** Fourie, P.J. (Nuclear Development Corp. of South Africa (Pty.) Ltd., Pelindaba, Pretoria. Isotope Production Centre). Oct 1983. CSIR, P.O. Box 395, Pretoria, 0001, South Africa. (CONF-8310380—).

From Mini-seminar on non-destructive testing; Pretoria, South Africa (1 Oct 1983).

The Isotope Production Centre of the Nuclear Development Corporation of South Africa manufactures and markets a large number of important radio-isotopes for use in the medical, industrial and research fields. Radio-isotope production may be grouped in three major product classifications: unprocessed radioactive material; radiochemical preparations and sealed radiation sources. The production of ^{192}Ir radiography sources is discussed in greater detail. This also includes the post-irradiation handling and the sealing of ^{192}Ir sources into source capsules. Stringent tests for leakage are an essential feature of radioactive source production.

31696 (DOE/ER/60084—4) **Development of the osmium-191 → iridium-191m radionuclide generator. Annual report.** Treves, S.; Packard, A.B. (Children's Hospital Medical Center, Boston, MA (USA). Dept. of Radiology). 30 Apr 1985. Contract AC02-82ER60084. 44p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85011185.

The use of /sup 191m/Ir in radionuclide angiography has been the subject of increasing interest in recent years. The ^{191}Os-/sup 191m/Ir generator that has been used for these studies suffers, however, from low /sup 191m/Ir yield (10%/ml) and higher than desirable ^{191}Os breakthrough (5 x 10^{-3}%). We have recently developed a /sup 191m/Ir generator that has higher yield (25 to 30%/ml) and lower breakthrough (<5 x 10^{-4}%) when eluted with an eluent (0.001 M oxalic acid/0.9% saline) that does not require buffering prior to injection. Studies within the last year have shown the eluate of this generator to be non-toxic at up to 100 times the expected human dose and work is in progress to obtain approval for human use of this system. While a significant improvement over past generator designs, the yield of this generator is still modest and the evaluation of new osmium complexes for use on the generator has continued. Clinical studies involving the use of /sup 191m/Ir for first-pass angiography in adults and children have continued. A comparison of ejection fractions measured in adults with both /sup 99m/Tc and /sup 191m/Ir has confirmed the feasibilty of /sup 191m/Ir for radionuclide angiography in both the left and right ventricles of adults. Studies in collaboration with Baylor Medical College have demonstrated the efficacy of /sup 191m/Ir in combination with the multi-wire gamma camera. 31 refs., 2 figs., 10 tabs.

31697 (IA—1404, pp 141-142) **Oxidation of tervalent uranium Usub(aq)sup(3+) by free radicals in aqueous solutions.** Cohen, H.; Golub, D.; Meyerstein, D. Jul 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85780940.

Published in summary form only.
In Research laboratories annual report 1983.

31698 (IA—1404, pp 95) **Synthesis of $Sb^{131}I_3$ crystals.** Ilzycer, D.; Weingarten, R. Jul 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85780940.

Published in summary form only.

In Research laboratories annual report 1983.

31699 (IA—1404, pp 161-162) **Method of preparation of tritium labeled ritalin at high specific activity.** Kaner, J.; Buchman, O.; Pri-Bar, I.; Shimoni, M. Jul 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85780940.

Published in summary form only.

In Research laboratories annual report 1983.

31700 (IA—1404, pp 162-163) **Tritium labeling of catecholamine by a catalyzed reductive debromination.** Buchman, O.; Shimoni, M.; Cohen, A.; Hagag, Y.; Pri-Bar, I. Jul 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85780940.

Published in summary form only.

In Research laboratories annual report 1983.

31701 (IA—1404, pp 164-165) **Preparation of high specific activity 2,4-dichloro phenoxy acetic acid (5-^3H).** Kaner, J.; Buchman, O.; Pri-Bar, I.; Shimoni, M. Jul 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85780940.

Published in summary form only.

In Research laboratories annual report 1983.

31702 (IA—1404, pp 165-166) **Synthesis of tritium labelled triglycerides.** Buchman, O.; Shimoni, M.; Cohen, A.; Pri-Bar, I. Jul 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85780940.

Published in summary form only.

In Research laboratories annual report 1983.

31703 (IA—1404, pp 166-167) **Synthesis of carbon-13 labeled compounds.** Pri-Bar, I.; Buchman, O. Jul 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85780940.

Published in summary form only.

In Research laboratories annual report 1983.

31704 (IA—1404, pp 167-168) **Synthesis of (-)-^{125}I-iodopindolol.** Solenchek, D.; Hirshfeld, N.; Canfi, I.; Teitelbaum, Z. Jul 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85780940.

Published in summary form only.

In Research laboratories annual report 1983.

31705 (IA—1404, pp 168) **Purification of ^{125}I iodohistamine.** Freud, A.; Canfi, A.; Solenchek, D.; Teitelbaum, Z. Jul 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85780940.

Published in summary form only.

In Research laboratories annual report 1983.

31706 (IA—1404, pp 168-169) **Iodination of the anti-estrogen tamoxifen via organo-metallic substitution.** Canfi, A.; Solenchek, D.; Teitelbaum, Z. Jul 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85780940.

Published in summary form only.

In Research laboratories annual report 1983.

31707 (IA—1404, pp 177-178) **Special protein iodination Part 2. The radioiodination of γ-globulin fragments (factor VIII Fab' fragments).** Canfi, A.; Solenchek, D.; Hirshfeld, N. (Israel Atomic Energy Commission, Tel Aviv); Zislin, A. (Ichilov Medical Centre, Tel Aviv (Israel)). Jul 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85780940.

Published in summary form only.

In Research laboratories annual report 1983.

31708 (IKMz—84-1) **Institut fuer Kernchemie, Univ. Mainz. Annual report 1983.** Weber, M. (Mainz Univ. (Germany, F.R.). Inst. fuer Kernchemie). 26 Nov 1984. 196p. (In German). NTIS (US Sales Only), PC A09/MF A01. File Number DE85751619.

This annual report contains extended abstracts about the work performed at the named institute together with a list of publications and speeches. The work concern fast chemical separations, the detection of short-lived nuclides, mass separations, nuclear spectroscopy, nuclear fission, heavy ion research, superheavy elements, radionuclide ecology, and the operation of the TRIGA Mainz reactor.

31709 (INIS-mf—9480) **12th international hot atom chemistry symposium, Balatonfuered, Hungary, 23-28 September 1984. Abstracts.** (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). Aug 1984. 98p. (CONF-8409214—Absts.). NTIS (US Sales Only), PC A05/MF A01. File Number DE85780930.

From 12. international hot atom chemistry symposium; Balatonfuered, Hungary (23 Sep 1984).

This proceedings contains the abstracts of 91 papers presented at the symposium. The majority of papers discusses various hot atom reactions and decay processes. A list of previous 11 international hot atom chemistry symposia from 1959 to 1982 is also given. One paper published in full length presents an overview of them (A.P. Wolf p. 89-89/b). (R.P.).

31710 (NUREG/CR—3293-Vol.1) **Technology, safety and costs of decommissioning reference nuclear fuel cycle and non-fuel cycle facilities following postulated accidents. Main report. Volume 1.** Elder, H.K. (Pacific Northwest Labs., Richland, WA (USA)). May 1985. Contract AC06-76RL01830. 327p. NTIS, PC A15/MF A01 - GPO. File Number TI85013021.

Technical requirements, costs and safety are conceptually evaluated for the post-accident cleanup and decommissioning of fuel cycle and non-fuel cycle facilities that have experienced a significant accident. Accident cleanup is postulated to include (1) initial decontamination of building surfaces to reduce the subsequent occupational dose to cleanup and decommissioning workers and (2) management of the resulting wastes. Decommissioning is assumed to follow accident cleanup. In order to ensure that worker doses are ALARA, despite higher radiation exposure to workers during post-accident operations, careful planning and rehearsal of cleanup operations and the use of remote and semi-remote cleaning techniques are required to reduce occupancy times in high-radiation areas and to minimize occupational exposures during accident cleanup. The public safety impacts of post-accident cleanup and decommissioning are also evaluated; these are below permissible radiation dose levels in unrestricted areas and well within the range of annual radiation doses from normal background.

31711 (NUREG/CR—3293-Vol.2) **Technology, safety and costs of decommissioning reference nuclear fuel cycle and non-fuel cycle facilities following postulated accidents. Appendices. Volume 2.** Elder, H.K. (Pacific Northwest Labs., Richland, WA (USA)). May 1985. Contract AC06-76RL01830. 298p. NTIS, PC A13/MF A01 - GPO. File Number TI85013022.

The following appendices are included in this volume: Reference Facility and Site Descriptions, Details of Reference Accident Scenarios and Resultant Contamination Levels, Generic Cleanup and Decommissioning Information, Details of MOX Plant Cleanup Decommissioning, Details of U-Fab Plant Cleanup and Decommissioning, Details of Non-Fuel Cycle Laboratory Cleanup and Decommissioning, Details of Ore Processing Site Cleanup and Decommissioning, Cost Estimating Bases, and Safety Assessment Details.

31712 (ORNL—6152, pp 76-92) **Chemistry of transuranium elements and compounds.** May 1985. NTIS, PC A10/MF A01. File Number DE85010586.

In Chemistry Division annual progress report for period ending January 31, 1985.

Studies are made in this program of high-pressure and of high-temperature properties of actinide metals and compounds. High-temperature synthetic work searching for new compounds of potential relevance for long-term storage of nuclear wastes is included as well as thermodynamic studies. Also, hydrides of the actinides are being investigated with particular emphasis placed on understanding the trend toward divalency shown at the heavy end of the actinide series (but not in the lanthanides). In other experiments, transuranium metals and compounds are placed under high pressure in order to force f orbital bonding and concomitant changes in structure which are analyzed by x-ray diffraction and by uv/vis spectroscopy. Studies of magnetic properties in metals and compounds determine experimental susceptibilities for comparison with theory as part of our focus on the characterization of 5f electrons in solids. Also a new focus is the investigation of the fundamental chemistry and physics of elements at the far reaches of the periodic table. Early emphasis will be on chemical properties of elements 101 to 105 as an indicator of the role of relativistic effects in controlling the architecture of the periodic table at the actinide-transactinide junction. This will involve "one-atom-at-a-time" chemical methodology including solvent extraction, ion exchange, electrochemistry, and volatility studies. 44 refs., 7 figs.

31713 **(UCAR—10062-83/1) Nuclear Chemistry Division annual report FY83.** Struble, G. (ed.). (Lawrence Livermore National Lab., CA (USA)). 1983. Contract W-7405-ENG-48. 255p. NTIS, PC A12/MF A01; 1; GPO Dep. File Number DE85012398.

The purpose of the annual reports of the Nuclear Chemistry Division is to provide a timely summary of research activities pursued by members of the Division during the preceding year. Throughout, details are kept to a minimum; readers desiring additional information are encouraged to read the referenced documents or contact the authors. The Introduction presents an overview of the Division's scientific and technical programs. Next is a section of short articles describing recent upgrades of the Division's major facilities, followed by sections highlighting scientific and technical advances. These are grouped under the following sections: nuclear explosives diagnostics; geochemistry and environmental sciences; safeguards technology and radiation effect; and supporting fundamental science. A brief overview introduces each section. Reports on research supported by a particular program are generally grouped together in the same section. The last section lists the scientific, administrative, and technical staff in the Division, along with visitors, consultants, and postdoctoral fellows. It also contains a list of recent publications and presentations. Some contributions to the annual report are classified and only their abstracts are included in this unclassified portion of the report (UCAR-10062-83/1); the full article appears in the classified portion (UCAR-10062-83/2).

31714 **Method for fluorination of actinide fluorides and oxyfluorides using O_2F_2.** Eller, P.G.; Malm, J.G.; Penneman, R.A. (to Dept. of Energy). US Patent Application 6-636,656. 1 Aug 1984. 9p. Contract W-7405-ENG-36.

The present invention relates generally to methods of fluorination and more particularly to the use of O_2F_2 for the preparation of actinide hexafluorides, and for the extraction of deposited actinides and fluorides and oxyfluorides thereof from reaction vessels. The experiments set forth hereinabove demonstrate that the room temperature or below use of O_2F_2 will be highly beneficial for the preparation of pure actinide hexafluorides from their respective tetrafluorides without traces of HF being present as occurs using other fluorinating agents: and decontamination of equipment previously exposed to actinides: e.g., walls, feed lines, etc.

31715 **Ion-molecule reactions and beam studies in relation to hot atom chemistry. Chapter 2-C.** Yoshihara, K. (Tohoku Univ., Sendai (Japan). Faculty of Science); Lee, Y.T. (California Univ., Berkeley (USA). Dept. of Chemistry; Lawrence Berkeley Lab., CA (USA)). pp 63-81 of Hot atom chemistry. Recent trends and applications in the physical and life sciences and technology. Matsuura, T. (Rikkyo Univ., Yokosuka, Kanagawa (Japan). Inst. for Atomic Energy) (ed.). Amsterdam, Netherlands; Elsevier (1984).

Includes subject index.

In this paper, some aspects of hot atom chemistry in the gas phase are discussed in detail. First, ion-molecule reactions are studied in relation to tritium chemistry. Decomposition processes by nuclear decay and by charge-exchange reactions are compared. Next, the use of crossed molecular beams in hot atom chemistry is discussed. The $Br^+ + CH_3I$ and $Br^+ + CF_3I$ reactions are investigated in more detail.

4008 Combustion, Pyrolysis, And High-temperature Chemistry

REFER ALSO TO CITATION(S) 31659, 31674, 31771

31716 **(AD-A—150144/4/XAB) Coherent structures in turbulent flames. Final report.** Chigier, N.A. (Sheffield Univ. (UK). Dept. of Fuel Technology and Chemical Engineering). Oct 1983. 32p. NTIS, PC A03/MF A01.

The objective of this research was to obtain increased understanding of turbulent combustion in flows related to propulsion systems. Measurement and data-analysis techniques, and the boundary conditions of various flames were designed to provide improved concepts and fundamental experimental data, to aid the development of modelling techniques for practical combustion systems. The specific approach of the study was to quantify the roles of large eddies (coherent structures) in reacting flows. The experiments and measurement techniques developed to attain this aim were described in previous Interim Scientific Reports. Measurements described here were made in the initial region of gaseous jet flames with separate variation in Reynolds number and equivalence ratio. These measurements produced detailed data on the structure of the initial regions of jet diffusion flames, as a function of systematic variation of initial burner nozzle conditions. These data are of considerable use for combustion modelling. Two associated experiments investigating the structures of turbulent liquid fuel sprays and impinging flames were carried out during the period of the contract.

31717 **(AD-A—150478/6/XAB) Laser diagnostic analyses of sooting flames. Final report, 1 October 1980-30 September 1984.** Dobbs, G.M.; Eckbreth, A.C.; Boedeker, L.R. (United Technologies Research Center, East Hartford, CT (USA)). 29 Nov 1984. 50p. (UTRC/R—84-955388-F). NTIS, PC A03/MF A01.

Prepared in cooperation with Princeton Univ., NJ. Dept. of Mechanical and Aerospace Engineering.

Temperature distribution and soot particle-size distributions were measured in axisymmetric, laminar, diffusion flames in order to provide the basis for modelling the influence of fuel structure and temperature on soot formation. This document is the final report and management summary for the joint activities of UTRC and Princeton University. Coherent anti-Stokes Raman spectroscopy (CARS) was used for nonintrusive determination of temperature. Soot particle size and number densities were determined by Mie scattering. The experimental results were then applied to current models of soot formation in an effort to determine the physical and chemical basis for fuel structure and temperature effects on soot formation in diffusion flames. In the course of this first application of CARS and Mie diagnostics to diffusion flames, a large number of questions was raised in regard to the structure of particulate-laden diffusion flames. Measured distributions were compared with a numerical flame-sheet model.

31718 **(DOE/ER/13170—2) Coalescence/dispersion modeling of turbulent combustion in a jet stirred reactor.** Butler, G.W.; Pratt, D.T.; Malte, P.C. (Washington Univ., Seattle (USA). Dept. of Mechanical Engineering). 1984. Contract AT06-84ER13170. 21p. (CONF-8404104—5; WSS/CI—84-13). NTIS, PC A02/MF A01; GPO Dep. File Number DE85011467.

From Spring meeting of the Combustion Institute; Boulder, CO, USA (2 Apr 1984).

In previous experimental studies of OH and O concentrations in high intensity turbulent combustion of methane in a jet-stirred reactor, a fully micromixed, perfectly stirred reactor (PSR) simulation model was shown to be inadequate for interpretation of the experimental results, due to the influence of finite-rate turbulent mixing near stoichiometric conditions. In the present work, a quantitative assessment of the interaction of finite-rate turbulent mixing and combustion chemistry is accomplished by means of a direct simulation using coalescence/dispersion modeling. A priori estimates of the reactor mixing frequency are compared with frequencies determined by empirically adjusting the coalescence/dispersion frequency to force agreement between measured and simulated profiles of mean temperature and species concentrations as a function of reactor equivalence ratio. The empirical values agree in order of magnitude with frequencies estimated either by consideration of global fluid dissipation length and time scales, or by characteristic reactor length and velocity scales. The simulations satisfactorily represent the measured temperature and species profiles over a wide range of equivalence ratios and, in direct contrast to the PSR predictions, show close agreement with the measured values near stoichiometric conditions. 15 refs., 7 figs.

31719 (LBL—18705) Soot and radiation in free boundary layer flames. Okoh, C.I. (Lawrence Berkeley Lab., CA (USA)). Dec 1984. Contract AC03-76SF00098. 137p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE85013185.

Soot volume fraction data on six fuels [toluene, cyclohexene, iso-octane, cyclohexane, polymethyl-methacrylate, n-heptane] in free, radiating, boundary layer, diffusion flames are presented along with approximate particle concentrations and size distributions used, and a brief discussion of the optical method employed to obtain them. A mathematical model is also presented for these flames. The soot and gas temperatures are shown to be locked, allowing the soot radiation to be included in the gas energy equation. The conservation equations are nondimensionalized and solved. Average transport and radiative properties are specified for the sooting flames studied, and rules are established for obtaining these properties. The absorption coefficient is presented for all the fuels. The values are consistent with the initial assumptions that the boundary layers examined are optically thin. Solutions are obtained for the temperature, species, and velocity fields and comparisons are made with corrected experimental thermocouple measurements. Gas streamlines are calculated, and thermophoresis is included in particle trajectory determinations. Soot mass conservation and carbon conversion are studied in the boundary layers. Soot mass flow rates and net generation rates are obtained. The normalized soot generation rates exhibit similarity near the flame. A simple Arrhenius correlation is introduced for calculating net generation rates, and is found to sufficiently describe the temperature dependence of the soot growth over the temperature range $1700K < T < 2200K$. The energy parameter is of 0(50 kcal/mole) and the pre-exponential is of 0(10^{9}Hz). The Arrhenius forms are integrated along trajectories to obtain predicted soot concentrations which agree well with experiment. 171 refs., 17 figs., 6 tabs.

31720 (LBL—19583) Theoretical studies of molecular interactions. Lester, W.A. Jr. (Lawrence Berkeley Lab., CA (USA)). May 1985. Contract AC03-76SF00098. 6p. (CONF-850578—3). NTIS, PC A02/MF A01; GPO Dep. File Number DE85012604.

From DOE/BES contractors' combustion meeting; Lake Geneva, WI, USA (22 May 1985).

The goal of this program is to extend fundamental knowledge of combustion processes by theoretical studies of the dynamics of energy transfer, reactive, and photodissociative processes. The approach is based on the reliable description of inter- and intramolecular interactions using ab initio methods and a variety of approaches to describe the dynamics of nuclear motion. A summary of recent results and future plans follows. 14 refs.

31721 (N—85-17088) Numerical calculation of the cold-flow characteristics of a bluff-body flame stabilizer. Ilegbusi, J.O.; Spalding, D.B. (Imperial Coll. of Science and Technology, London (UK)). Jul 1984. 27p. (CFD—84/14). NTIS, PC A03/MF A01.

The numerical prediction of turbulent flow behind a wedge-shaped flame stabilizer is described. The wedge is represented as a blockage in the flow. A model of turbulence characterized by the turbulence energy and a measure of the time-mean-square of the vorticity fluctuations is employed. The flow situations include cases with and without a nozzle upstream of the bluff body that simulates a lean-mixture combustor. Results based on these features are compared with the data for a 45 deg wedge angle. The predicted and measured size of the recirculation zone, mean velocity, pressure coefficients, shear stresses and turbulence energy are in fair agreement downstream of the stabilizer. (ESA)

31722 (N—85-17089) Two-fluid model of turbulence applied to combustion phenomena. Spalding, D.B. (Imperial Coll. of Science and Technology, London (UK)). Oct 1984. 56p. (CFD—84/15). NTIS, PC A04/MF A01.

Turbulent fluids are treated as random interspersions of two fluids, each possessing its own temperature, composition, velocity components, etc, and interacting through the sharing of space and the exchange of mass, momentum and energy. The model is applied to transient combustion of premixed fuel gas and air, partially confined in a duct. Research on two-dimensional steady flame phenomena is summarized. (ESA)

31723 (UCID—20385) Investigation of the flame speeds of propane/methanol gas mixtures. Foote, K.L.; Villareal, J. (Lawrence Livermore National Lab., CA (USA)). 2 May 1985. Contract W-7405-ENG-48. 16p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85012817.

A series of tests was conducted in an acoustically tuned flame tube in order to determine the laminar burning velocities in air of various propane/methanol gas mixtures. The experimental method is explained in detail, along with the tabular results. A 90% propane, 10% methanol mixture is shown to have a maximum burning velocity of 40.8 cm/s. A 65% propane, 35% methanol mixture has a maximum velocity of 41.8 cm/s. These maximum flame speeds are shown to be about the same as that of pure propane by the same method. Gulder has found evidence that the presence of methanol in some hydrocarbon fuels may actually inhibit combustion, but we see no apparent modifications in the combustion of propane when mixed with methanol.

31724 Simultaneous two-dimensional mapping of species concentration and temperature in turbulent flames. Long, M.B.; Levin, P.S.; Fourguette, D.C. (Department of Mechanical Engineering and Center for Laser Diagnostics, Yale University, New Haven, Connecticut 06520). *Optics Letters;* **10**: No. 6, 267-269(Jun 1985).

A new technique has been developed that permits simultaneous two-dimensional mapping of two scalar components (e.g., species and temperature) in a turbulent reacting flow. The technique uses two optical multichannel analyzers, each of which detects light scattered by a different mechanism (e.g., Rayleigh and Raman) and thus provides different information. The technique has been applied to both premixed and nonpremixed flames, and results are reported for each. The simultaneous information obtained in these experiments should provide new data on the interaction of turbulence and combustion in these chemically reacting flows.

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4201 General Engineering

31725 (UCRL—15669) Fiber-optics cable failure analysis. Scarton, H.A.; Spillers, W.R. (Rensselaer Polytechnic Inst., Troy, NY (USA). Dept. of Civil Engineering). May 1984. Contract W-7405-ENG-48. 35p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85012965.

The work reported is motivated by the mechanical failure of optical fibers in fiber optic cables used in underground testing at the Nevada Test Site. Focus is on basic mechanical tests, simulation of in-situ cable behavior, and proof tests. Preliminary flexure, creep, and tension test results are given together with both mechanical and optical instrumentation. (LEW)

31726 **(UCRL—88927) Applying molecular dynamics to fracture.** Hoover, W.G.; Moran, B. (California Univ., Davis (USA). Dept. of Applied Science; Lawrence Livermore National Lab., CA (USA)). Mar 1983. Contract W-7405-ENG-48. 13p. (CONF-830292—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85012966.

From Joint Army Research Office/National Science Foundation workshop on fracture; Pasadena, CA, USA (16 Feb 1983).

An attempt has been made to understand the structure of rapidly moving cracks and to simulate their shadow patterns numerically. The particle trajectories are generated using molecular dynamics, and then shadow patterns are developed and compared with experimental results. By "molecular dynamics" is meant the solution of the microscopic atomistic equations of motion as relates to crack movement. The method is briefly outlined, as well as results and remaining difficulties. (LEW)

4202 Facilities And Equipment

REFER ALSO TO CITATION(S) 29629, 29630, 29705, 29712, 29892, 30318, 30780, 30780, 30780, 30781, 30782, 30783, 30784, 30785, 30785, 30785, 30790, 30794, 30794, 30795, 30796, 30796, 30796, 30797, 30797, 30798, 30798, 30799, 30799, 30800, 30800, 30801, 30801, 30802, 30802, 30803, 30803, 30804, 30805, 30805, 30806, 30806, 31582, 31984, 33010

31727 **(AD-A—150319/2/XAB) Survey of the state-of-the-art of miniature cryocoolers for superconductive devices. Final report.** Smith, J.L.; Robinson, G.Y.; Iwasa, Y. (Naval Research Lab., Washington, DC (USA)). 31 Dec 1984. 63p. (NRL-MR—5490). NTIS, PC A04/MF A01.

This document presents the results of a survey of the state-of-the-art as applied to cryocoolers to cool small superconducting devices. The survey included visits to over 100 facilities involved in the production or development of small cryocoolers in the United States, Japan, Europe. Specifications of commercially available cryocoolers having capacities of one to five watts in the 80 to 4 K range are presented.

31728 **(AD-A—151112/0/XAB) Synthesis and characterization of superconducting electronic materials. Final technical report, 1 July 1982-30 September 1984.** Meservey, R.H.; Tedrow, P.M.; Orlando, T.P. (Massachusetts Inst. of Tech., Cambridge (USA). Francis Bitter National Magnet Lab.). 15 Nov 1984. 17p. NTIS, PC A02/MF A01.

Specialized vacuum deposition systems were developed with the necessary monitoring and control to synthesize or react refractory superconducting films. NbN, VN, NbTi, and VTi films of high quality were produced and their transport and tunneling properties studied. Ultra-thin films of pure Nb have been successfully made to study spin-orbit scattering in transition metals. The structural properties and penetration depth of NbN films prepared by reactive sputtering were studied. Many-body effects, important in superconductivity, were observed by spin-polarized tunneling and the antisymmetric Fermi liquid parameter was measured for the first time in Al. The technique of deconvoluting tunneling conductance curves to obtain the superconducting density of states has been improved. A comprehensive study was made of amorphous Ge tunnel barriers between superconductors.

31729 **(AD-A—151465/2/XAB) Stability and vibrations of internal windings of high-current superconducting solenoid magnets. Technical report.** Hara, K.; Moon, F.C. (Cornell Univ., Ithaca, NY (USA). Dept. of Structural Engineering). Dec 1984. 168p. NTIS, PC A08/MF A01.

High-field-solenoid magnets may experience internal damage or eventually collapse due to the powerful magnetic fields they produce. Elastic deformations of the conductor and insulation in these magnets deserve attention because they can cause local damage that can lead to electrical breakdown. In conventional stress analysis of cylindrically wound magnets, the magnetic field gradient, or magnetic stiffness, is usually neglected. However, in this thesis the magnetic stiffness is shown to have a significant effect on the elastic stability and vibration of these magnets. One-turn and multi-turn superconducting rings were used to study the effects of deformations on stability and vibration. Both static and dynamic methods were used to determine the critical buckling currents. The dispersion of natural frequencies with increase in current and subsequent in-plane and out-of-plane buckling of the rings near the critical buckling current were observed. A model based on ring theory and magnetic stiffness was developed to explain experimental observations and showed a fair to good agreement between experimental and theoretical values of the buckling current. This model was used to evaluate the buckling current of 7- and 10-turn magnets. The analysis showed buckling concentrated in the outer turns.

31730 **(AD-A—954082/4/XAB) Night-work lighting systems for construction equipment. Interim report No. 1.** Cashell, C.F. (Engineer Board, Fort Belvoir, VA (USA)). 24 May 1946. 141p. NTIS, PC A07/MF A01.

This U/A report covers a study of the lighting requirements to permit efficient night operation of the power cranes, road graders, road rollers, tractors, tractor-operated cranes, water distributors, and ditching machines used by the Corps of Engineers; describes the development of suitable lighting and electrical power equipment; and sets forth data on the proper location of the equipment in order to meet lighting requirements. After development of suitable lighting equipment, the determination of the type, number, and optimum location of the lighting fixtures required for each item of construction equipment was made in the field in a long series of night operations with skilled operators obtained from the Engineer School, including expert instructors from the training courses of that organization and men with long records of service in civilian construction and military construction in the theaters of operation. Included in the report are specifications covering all materials and parts required for the lighting systems developed.

31731 **(CAPE—2945) In-cell welding fixture. Remote welder assembly, Model II (Engineering Materials).** (Oak Ridge National Lab., TN (USA)). 1 Feb 1985. Contract AC05-84OR21400. H. File Number TI85011048.

7 35-mm aperture cards.

The remote welder assembly provides the mechanical apparatus for remotely welding cylindrical, metallic capsules containing radioactive materials. It consists of a rotating chuck and welding electrode with positioning controls operable by master-slave manipulators.

31732 **(CEA-CONF—7349) High magnetic field and very low temperature cryomagnet for neutron scattering experiments.** Rossat-Mignod, J.; Olivier, J.; Burlet, P. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). Feb 1984. 20p. (CONF-840263—3). NTIS (US Sales Only), PC A02/MF A01. File Number DE85751303.

From Workshop on sample environments in neutron and x-ray experiments; Grenoble, France (13 Feb 1984).

A cryomagnetic system is described in which the main components are a cryostat providing variable temperatures and a superconducting magnet. The cryostat enables the magnet to operate either at 4.2 K or 2.17 K and the sample temperature to be varied from 1.5 K to 300 K. The magnet is a split coil providing a vertical magnetic field of 8.7 T at 4.2 K and 10 T at 2.17 K. A ^{3}He - ^{4}He dilution refrigerator insert can be used to reach T=50 mK. A few significative experimental results are presented concerning UAs, CeSb, CeB$_6$ and TMMC.

31733 **(CEA-CONF—7386) Composition modulation measurements in thin 2D-superconducting multilayers.** Villegier, J.C.; Blanchard, B.; Laborde, O. . (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). Aug 1984. 3p. (CONF-840842—32). NTIS (US Sales Only), PC A02/MF A01. File Number DE85751300.

From 17. international conference on low temperature physics; Karlsruhe, F.R. Germany (15 Aug 1984).

Superconductive and resistive properties of Nb-Al coherent multilayers are measured in the case of a small number of 6 nm thick layers. A strong anisotropy of critical fields (Hsub(parallel)/Hsub(perpendicular)) > 2.1) and a low Hsub(parallel) approximately (T-Tsub(c)) (near Tsub(c)) are observed indicating a complex 2D-superconducting behavior. A direct observation of the composition modulation is developed associating a selective "layer by layer" etching technique with structure and SIMS depth profiling analysis.

31734 **(CEA-CONF—7441) Thermal cycling machine for cryoelectronic devices characterization.** Locatelli, M.; Desmaris, M.; Villegier, J.C. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). 1984. 3p. (CONF-840705—8). NTIS (US Sales Only), PC A02/MF A01. File Number DE85751595.

From 10. international conference on cryogenic engineering; Espoo, Finland (31 Jul 1984).

We present the main characteristics of a full automatic machine for thermal cycling of cryoelectronic devices between 4.2 K and an annealing temperature below 350 K. This machine has been used for cycling NbN-oxide-Pb(In)Josephson devices for more than 800 times without any significant parameters change.

31735 **(CEA-CONF—7442) Automatic point testing machine at 78 K.** Lagnier, R.; Bedin, E.; Tribolet, P. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). 1984. 3p. (CONF-840705—7). NTIS (US Sales Only), PC A02/MF A01. File Number DE85751594.

From 10. international conference on cryogenic engineering; Espoo, Finland (31 Jul 1984).

We describe an automatic point probe apparatus, that allows electrical testing of cryoelectronic devices at 78 K. The measurements are done by automatic displacement and positioning of the contact pin on the 1 in. diameter sample. The number of tests on each device, usually about 2000, is done in the shortest possible time.

31736 **(CEA-CONF—7443) Dynamic cooling system for cryogenics sensors.** Locatelli, M.; Chiron, C.; Pocachard, J. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). 1984. 4p. (CONF-840705—6). NTIS (US Sales Only), PC A02/MF A01. File Number DE85751593.

From 10. international conference on cryogenic engineering; Espoo, Finland (31 Jul 1984).

We propose a dynamic cooling system which compared to the static method presents the following advantages: low cost, low cryogenic liquid consumption (helium), large ability for different experiments and easy to use for the non specialists.

31737 **(DP-MS—85-31) What is validation.** Clark, H.K. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1985. Contract AC09-76SR00001. 23p. (CONF-850917—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE85011508.

From Topical meeting on criticality safety and the storage of fissile material; Jackson, WY, USA (9 Sep 1985).

Criteria for establishing the validity of a computational method to be used in assessing nuclear criticality safety, as set forth in "American Standard for Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors," ANSI/ANS-8.1-1983, are examined and discussed. Application of the criteria is illustrated by describing the procedures followed in deriving subcritical limits that have been incorporated in the Standard.

31738 **(JAERI-M—84-020) Shielding experiments for evaluating a shielding safety evaluation code system to spent fuel processing facilities, (4). Experiments for the assessment on source geometry of BWR spent fuel assemblies.** Tanaka, Shun-ichi; Sakamoto, Yukio; Yamaji, Akio. (Japan Atomic Energy Research Inst., Tokyo). Feb 1984. 50p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. File Number DE85701056.

Shielding experiments of a spent fuel transport cask were performed using two BWR spent fuel assemblies according to the experimental plan to confirm the reliability of a shielding safety evaluation code system and data libraries. The experiment was made using two BWR spent fuel assemblies with a same burnup and cooling history. The distributions of gamma-ray dose rate and ^{235}U and ^{232}Th fission rates were measured around each assembly and two assemblies. The maxima of gamma-ray exposure dose rate and ^{235}U fission rate were observed at about one to third of fuel length from the bottom. The intensities above the position were decreased along the upper direction, where the fission rate was more steeply than the gamma-ray dose rate. This report gives the data of the experimental conditions and the detector characteristics necessary for the analysis of the experiments as well as the measured data.

31739 **(JINR—8-84-165) Thermodynamic analysis and optimization of cryogenic helium systems with satellite refrigerators.** Agapov, N.N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1984. 11p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85701001.

Optimal power mode cryogenic helium systems with satellite refrigerators have been calculated to refrigerate superconducting magnetic systems of accelerators. Information is presented on specific power compressed gas and liquid helium comsumptions for refrigeration in the satellite. The flow-diagrams of satellite refrigerators with an expansion engine, single and intermediate throttling are analysed. A comparison of different flow-diagrams is made for the same surface of heat exchangers of the satellite refrigerators. An optimal value of this heat exchange surface is determined. It is considered how the necessity of helium circulation in a cryogenic device affects parameters of the satellite refrigerators (for two-phase helium). The use of an ejector in a satellite refrigerator allows the vapour content of two-phase helium to be reduced significantly at the output of the cryogenic device without excessive power consumption unavoidable in single circulation flow-diagrams.

31740 **(KFK—3857) Plating-out of droplets and particles with diameter from 1-9 μm in horizontal pipes and in 90° pipe bends.** Furrer, J.; Dillmann, H.G.; Linek, A. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Lab. fuer Aerosolphysik und Filtertechnik 2; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Wiederaufarbeitung und Abfallbehandlung). Dec 1984. 21p. (In German). (PWA—104/84). NTIS (US Sales Only), PC A02/MF A01. File Number DE85751621.

This report presents the types of calculation as well as the results as diagrams which can be used as a basis for estimating plating out of aerosols in horizontal pipeworks and in 90° pipe bends. The calculations were carried out to comply with many inquiries concerning this problem addressed by industry and research institutions.

31741 **(LA—10367-MS) Enhanced heat transfer computations for internally cooled cable superconductor.** Rogers, J.D. (Los Alamos National Lab., NM (USA)). Mar 1985. Contract W-7405-ENG-36. 9p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85011897.

Superconducting magnets are built with conductors that are pool bath cooled, internally cooled with the superconductor cabled and contained within a conduit, or conduction cooled. The first two embody superconductors in direct contact with liquid helium. Practical designs of internally cooled cable superconductor (ICCS) are not cryostable. Such superconductors have shown multiple regions of stability and instability. A computational method of adjusting the heat transfer coefficient of a one dimensional system of equations to enhance joule heat removal, primarily in the central region of a pulse heated model of ICCS, has been used to attempt simulation of the multiple stability/instability experiment.

31742 **(LA-UR—85-1149) Pulsed hydrojet propulsion.** Bohachevsky, I.O.; Torrey, M.D. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 29p. (CONF-850712—4). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85010771.

From 21. AIAA/ASME/SAE joint propulsion conference; Monterey, CA, USA (8 Jul 1985).

The pulsed hydrojet is a device in which the water ingested from the free stream is accelerated out of the exhaust pipe to produce thrust. In this report we describe and analyze a way of accelerating the stream of water with pockets of high pressure steam and gas generated inside the stream by an exothermal reaction of suitable propellant injected and dispersed in the water. The velocity increment that must be imparted to the water to produce a substantial thrust need not be very large because the density of the water is comparable to the average density of the accelerated body. Results of the numerical modeling of the proposed jet acceleration mechanism indicate that the hydrojet propulsion device is potentially capable of propelling underwater projectiles at speeds three to five times greater than those currently attainable. Several promising applications of the hydrojet thruster are discussed and evaluated.

31743 (N—85-16180) **Clearance flow-generated transverse forces at the rotors of thermal turbomachines.** Urlichs, K. (National Aeronautics and Space Administration, Washington, DC (USA)). Oct 1983. 181p. (NASA-TM—77292). NTIS, PC A09/MF A01.

Self-excited rotor whirl represents a serious hazard in the operation of turbomachines. The reported investigation has, therefore, the objective to measure the lateral forces acting on the rotor and to determine the characteristic pressure distribution in the rotor clearance area. A description is presented of an approach for calculating the leakage flow in the case of an eccentric rotor position on the basis of empirical loss coefficients. The results are reported of an experimental investigation with a turbine stage, taking into account a variation of the clearance characteristics. The pressure data measured are consistent with the theoretical considerations. G.R. (IAA)

31744 (NUREG/CR—0200-Vol.1, pp vp, Section S2) **SAS2: a coupled one-dimensional depletion and shielding analysis code.** Hermann, O.W. (Oak Ridge National Lab., TN). Dec 1984. NTIS, PC A99/MF A01. File Number TI85007563. (ORNL/NUREG/CSD—2/Vol.1).

In SCALE: a modular code system for performing standardized computer analyses for licensing evaluation. Volume 1. Control modules.

The SAS2 control module computes gamma and neutron dose rates at distances from a specified shipping cask, containing fuel assemblies of a given reactor history and cooling time. Time-dependent cross sections for the reactor characteristics are computed from one-dimensional transport neutronics modules, which account for resonance self-shielding. A matrix exponential expansion model computes time-dependent material densities applied in the cross-section production and the shipping cask analysis. Functional modules of the SCALE system activated by SAS2 are: BONAMI-S, NITAWL-S, XSDRNPM-S, COUPLE, ORIGEN-S, and XSDOSE. The document presents input requirements, computational procedures, applications and uncertainties, subroutine descriptions, and sample problems.

31745 (NUREG/CR—0200-Vol.1, pp vp, Section H1) **HTAS1: a two-dimensional heat transfer analysis of fuel casks.** Turner, W.D.; Cobb, C.K. (Oak Ridge National Lab., TN). Dec 1984. NTIS, PC A99/MF A01. File Number TI85007563. (ORNL/NUREG/CSD—2/Vol.1).

In SCALE: a modular code system for performing standardized computer analyses for licensing evaluation. Volume 1. Control modules.

The Heat Transfer Analysis Sequence Number One (HTAS1) control module was developed for the United States Nuclear Regulatory Commission to perform standardized thermal analyses on a class of nuclear fuel shipping containers. HTAS1, a control module in the SCALE system where SCALE is an acronym for Standardized Computer Analyses for Licensing Evaluation, uses the HEATING6 functional module to perform the prescribed thermal analysis. The nuclear fuel shipping container must be composed of acceptable combinations of zones consisting of a cavity, an inner shell shielding, an outer shell, a neutron shield, a water jacket, and impact limiters. Thermal properties for the material in each zone may be extracted from a material property library or may be supplied by the user. The desired thermal analysis of the nuclear fuel shipping container is defined by an analytical sequence composed of one or more of the following calculations chosen in an acceptable order: an initial steady state; a prefire steady state; a fire transient; a postfire transient; and a final steady state. Each calculation in an analytical sequence specifies the type (steady state or transient), the ambient temperature, the duration of any transient, and the heat transfer mechanisms at the surface of the model. Selected portions of the model may be deleted at certain points in an analytical sequence to simulate changes in the nuclear fuel shipping container during an analysis. The model and analytical sequence are described to HTAS1 using free-form, keyword-oriented data making extensive use of defaults.

31746 (NUREG/CR—0200-Vol.2, pp vp, Section F12) **JUNEBUG-II: a three-dimensional geometry plotting code.** Emmett, M.B.; Petrie, L.M.; West, J.T. (Oak Ridge National Lab., TN). Dec 1984. NTIS, PC A99/MF A01. File Number TI85007576. (ORNL/NUREG/CSD—2/Vol.2).

In SCALE: a modular code system for performing standardized computer analyses for licensing evaluation. Volume 2. Functional modules.

The JUNEBUG-II code is an exceptionally valuable tool which is used to verify and validate three-dimensional (3-D) combinatorial geometry and KENO geometry models. It uses the MARS geometry system for modeling complicated multiple array lattices as well as simple combinatorial geometry models. Input for JUNEBUG-II is very flexible and will accept standard KENO-IV input data, as well as combinatorial MARS geometry input. JUNEBUG-II is an improved version of JUNEBUG which has been updated to provide faster running times and more efficient storage allocation. Variable I/O units are now used, a new and more efficient COMMON structure has been developed, and program errors detected by users have been eliminated. Subsections are introduction, input, program flow, subroutine description, and sample problems.

31747 (PEL—284) **Computer modelling of the flow of air and aerosols through and onto porous filters, and some applications and modifications of the Parker model.** Rossouw, J.W.; Leuschner, A.H. (Nuclear Development Corp. of South Africa (Pty.) Ltd., Pelindaba, Pretoria). Feb 1984. 20p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85701484.

A brief overview of a theoretical model for the movement of aerosol particles through a pore in a filter is given. The aim of the report is to describe the calculation methods involved in the theoretical determination of the impaction efficiency of a Nuclepore filter, consisting of cylindrical holes. The Navier-Stokes equations, derived from a continuum mechanics in terms of a stream function Y and a vorticity vector w, have been used to describe the flow through a cylindrical pore. These equations were solved numerically and the results used to obtain the air velocity at a discrete grid of spatial points. By assuming that Stokes drag force acts on a particle moving with the air towards the pore, a particle trajectory has been calculated. Thus it could be determined wether a particle has deposited on the filter or has passed through the pore in the filter. The interception and impaction efficiencies for subsequent particles after a single particle deposition, have also been investigated.

31748 (SAND—85-0173C) **Testbed for sensory control of intelligent machines.** Donohoe, G.W. (Sandia National Labs., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 13p. (CONF-8505122—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE85012355.

From EPES '85 - energy, power and environmental systems international conference; Santa Barbara, CA, USA (29 May 1985).

The Intelligent Machine Systems Division of Sandia National Laboratories is engaged in the development of the sensory control of robots to perform human-like tasks in hostile environments, such as the remote maintenance of a nuclear reactor. Such a robot should be able to operate in a relatively unstructured environment. It should be able to monitor the progress of a task, verifying that things are proceeding as planned. If they are not, the robot should be able to detect this and take corrective action. In collaboration with the University of New Mexico, the laboratory has constructed a sensor-driven robot testbed for exploring these issues.

31749 (STEV-SB—83-36) **Tests of loading techniques for biomass, in particular tree stumps.** Goetblad, R. (Statens Energiverk, Stockholm (Sweden)). 1983. 39p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. File Number DE85750865.

In this project, efficient techniques for loading wood wastes, in particular stumps, has been developed. It was found that a combination vehicle, to be used for stump extraction, loading and ditching was more cost effective than a special machine. Such a combination vehicle was developed from a Aakerman H12B excavator, and was tested during four months under shifting conditions and using all its equipment.

31750 **(UCRL—15661) Processing and problems in manufacturing MJR billets of four separate compositions for Lawrence Livermore National Laboratory.** McDonald, W.; Smathers, D.B.; O'Larey, P.M.; Siddall, M. (Teledyne-Wah Chang, Albany, OR (USA)). 28 Jan 1985. Contract W-7405-ENG-48. 15p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85012978.

Four separate compositions of superconducting composites (Nb/bronze) were produced, drawn to 0.9 mm dia and containing 2.9:1 volume ratio of bronze to niobium. Critical current density was measured for each heat treatment. Some of the bronze used also contained 0.25 wt % titanium. 2 figs., 6 tabs. (DLC)

31751 **(UCRL—92050) Field measurement of tension in a T-142 tank track.** Trusty, R.M.; Wilt, M.D.; Carter, G.W.; Lesuer, D.R. (Lawrence Livermore National Lab., CA (USA)). Apr 1985. Contract W-7405-ENG-48. 11p. (CONF-850608—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85011845.

From Spring conference on experimental mechanics; Las Vegas, NV, USA (9 Jun 1985).

This paper describes a method used to measure the tension developed between neighboring track sections of a T-142-track mounted on an M-60 tank at the Yuma Proving Grounds. Such information is important for input to the computer models being developed for the US Army Tank-Automotive Command. A section of track was instrumented with strain gages and mounted in a tensile testing machine. The strain gage output was calibrated as a function of tension. The calibrated track section was mounted on the tank and connected through a hard-wire electrical tether to a portable data acquisition system. A video recording system with a clock common to the data acquisition system was used to correlate environmental inputs to tension data. Initial track pretension levels were measured. Data were also acquired when the tank traversed several objects, moved uphill over an obstacle, and executed pivot turns. This data has been used in the new computer models.

31752 **Design of resilient processing plants. VII. Design of energy management system for unstable reactors - new insights.** Morari, M.; Grimm, W.; Oglesby, M.J.; Prosser, I.D. (Univ. of Wisconsin, Madison). *Chemical Engineering Science;* 40: No. 2, 187-198(1985). Contract AC02-80ER10645.

In previous parts of this series methods were developed for the design of plants which are not only optimal at some nominal operating point but which can also deal effectively with disturbances and changes in the operating conditions. These techniques are extended here and applied to synthesize the heat exchanger network and the control structure for a sequence of two exothermic open-loop unstable continuous stirred tank reactors.

31753 **Critical experiment needs and plans of the consolidated fuel reprocessing program.** Primm, R.T. (Oak Ridge National Laboratory, TN (USA)). pp 258-273 of Proceedings of the international seminar on criticality studies programs and needs. Is-sur-Tille, France; Commissariat a l'Energie Atomique (1984). (CONF-8309105—).

From International seminar on criticality experiments and data; Dijon, France (20 Sep 1983).

An integral part of the United States Department of Energy (DOE) plan for the development of breeder reactors is the development of the capability for fuel reprocessing. The Consolidated Fuel Reprocessing Program (CFRP) was established by the DOE to identify and conduct research and development activities in this area. The DOE is currently proposing that a capability to reprocess fast reactor fuel be established in the Fuels and Materials Examination Facility at the Hanford Engineering Development Laboratory. This capability would include conversion of plutonium nitrate to plutonium oxide. The reprocessing line is designated the Breeder Reprocessing Engineering Test (BRET). Criticality safety remains an important critetion in the design of the BRET. The different steps in the reprocessing are reviewed and areas where additional critical experiments are needed have been indentified as also areas where revision or clarification of existing criticality safety standards are desirable.

4203 Lasers

REFER ALSO TO CITATION(S) 31678, 31979, 32376, 32476, 32484, 32535, 32536, 33029

31754 **(AD-A—150292/1/XAB) Pulsed hydrogen-fluoride laser.** McLeary, R. (Materials Research Labs., Maribyrnong (Australia)). May 1984. 15p. (MRL-R—931). NTIS, PC A02/MF A01.

This report describes a pulsed hydrogen-fluoride laser constructed at MRL. The laser delivers an energy of 7 J in a microsecond pulse from vibrational-rotational transitions in the wavelength region 2.6-3.1-micrometers. It simultaneously produces 1 mJ of energy in a 1 microsecond pulse from pure rotational transitions in the wavelength region 10-17 micrometers.

31755 **(AD-A—150299/6/XAB) Near field/far field (nf/ff) energy loss in electric-discharge lasers (EDL's): a mode-medium interaction. Technical report.** Bentley, J.H. (Army Missile Command, Redstone Arsenal, AL (USA). Directed Energy Directorate). Aug 1984. 10p. NTIS, PC A02/MF A01.

High-energy CO_2 EDL's (Electric Discharge Lasers) with unstable resonators exhibit a mode-medium interaction that spreads the focused beam and causes loss in the far-field. Mirror edge Fresnelling may result in amplified feedback, which causes a parallelpiped structure to be burned into the lasing medium. Possible confirming experiments are described.

31756 **(AD-A—151199/7/XAB) Bibliography of Soviet laser developments, Number 67, September-October 1983.** (Defense Intelligence Agency, Washington, DC (USA). Directorate for Scientific and Technical Intelligence). 5 Dec 1984. 124p. (DIA-DST—2700Z-001-85). NTIS, PC A06/MF A01.

This is the Soviet Laser Bibliography for September-October 1983, and is No. 67 in a continuing series on Soviet laser developments. The coverage includes basic research on solid state, liquid, gas, and chemical lasers; components; nonlinear optics; spectroscopy of laser materials; ultrashort pulse generation; crystal growing; theoretical aspects of advanced lasers; and general laser theory. Laser applications are listed under biological effects; communications; beam propagation; adaptive optics; computer technology; holography; laser-induced chemical reactions; measurement of laser parameters; laser measurement applications; laser-excited optical effects; laser spectroscopy; beam-target interaction; and plasma generation and diagnostics.

31757 **(AD-A—151372/0/XAB) Calculations of collision-induced optical gain in high-density mixtures of D2 or HD with a buffer gas.** McLeary, R. (Materials Research Labs., Maribyrnong (Australia)). Oct 1984. 32p. (MRL-R—939). NTIS, PC A03/MF A01.

This report presents the results of calculations of collision-induced optical gain in vibrationally-excited mixtures of deuterium or hydrogen deuteride with a buffer gas. Gains of up to 0.07/cm are predicted for gas mixtures at high pressure and reduced temperature. Significant gain is predicted over a frequency range of approximately 2100/cm to 2700/cm (wavelength range 4.8 to 3.7 micrometers) for D2 mixtures and over the frequency range 2600/cm to 3300/cm(wavelength range 3.8 to 3.0 micrometers) for HD mixtures. These results indicate the feasibility of operation of collision-induced-dipole lasers which are continuously tunable over the above frequency ranges.

31758 (AD-A—151731/7/XAB) Spectroscopic investigation of materials for frequency-agile laser systems. Final report, 15 January 1982-14 January 1985. Powell, R.C. (Oklahoma State Univ., Stillwater (USA). Dept. of Physics). Jan 1985. 141p. NTIS, PC A07/MF A01.

This research involves the use of laser-spectroscopy techniques such as four-wave mixing, multiphoton absorption, time-resolved site-selection spectroscopy, and holography to characterize dynamical optical processes such as energy transfer, exciton migration, radiation-less relaxation, and the photorefractive effect. In addition, a significant effort was spent in the synthesis and characterization of new types of materials for tunable laser applications. The materials investigated include alexandrite, titanium-doped sapphire, lithium niobate, neodymium pentaphosphate, rhodium-doped rubidium calcium fluoride, manganese silicate, and neodymium-doped garnet crystals and glasses.

31759 (AD-A—151742/4/XAB) Collective effects in the free electron laser (FEL). Sprangle, P.; Tang, C.M.; Roberson, C.W. (Naval Research Lab., Washington, DC (USA)). 1984. 46p. NTIS, PC A03/MF A01.

With intense relativistic electron beams, such as generated by induction linear accelerators, pulsed-transmission-line accelerators or high-current RF linacs, collective effects can play an important role in the FEL process. High-gain FELs are said to operate in the Raman regime when collective effects dominate the usual ponderomotive effects. Collective effects may also play an important role in low-gain FELs when the beam current is sufficiently high. In this paper the linear and nonlinear dynamics of the FEL mechanisms, including space charge effects, is analyzed. The various collective and noncollective operating regimes are discussed.

31760 (AD-A—151760/6/XAB) High-gain xuv and x-ray free-electron lasers. Tang, C.M.; Sprangle, P. (Naval Research Lab., Washington, DC (USA)). 1984. 13p. NTIS, PC A02/MF A01.

Presented at the Free Electron Generation of Extreme Ultraviolet Coherent Radiation, AIP Conference 1984.

The operation of the free electron laser (FEL) oscillator in the xuv and x-ray regimes requires high-gain per pass to overcome somewhat large mirror losses. This paper summarizes the growth rates and intrinsic trapping efficiencies in the high gain regimes, and comments on various three-dimensional effects.

31761 (N—85-17182) Construction, testing of 1-MW nitrogen laser. Weidauer, R.; Glismann, A.; Konig, R.; Falk, H. (Joint Publications Research Service, Arlington, VA (USA)). Dec 1984. 2p. NTIS, PC A03/MF A01.

In its East Europe Report, science and technology, 40-41 p. (N—85-17176 08-31).

Nitrogen lasers (N2-lasers) have achieved considerable importance since their discovery in 1963. Preferred as pump light sources for nanosecond pigment lasers they are also used in photolysis experiments, fluorescence decay time measurements, in the determination of air pollution, the detection of oil traces or in material processing in semiconductor and microelectronics. The laser energy was measured by means of an absolutely calibrated, pyroelectric receiver; the pulse shape was determined by means of a fast photocell in combination with an SU-oscilloscope I 2-7. The time resolution of the overall system was about 0.5 ns. For measurements it was important to take into account that besides the strong UV-radiation at 337.1 nm, radiation was also emitted in the near IR between about 870 nm and 900 nm. The IR pulse exits from the laser with about 10 ns delay to the UV-pulse; its pulse width was measured at 7 ns, whereas that of the UV-signal amounts to 12 ns under optimum conditions. The energy in the IR-range amounts to around 5 percent of the UV-energy. By means of a dielectric edge filter (KCZ) the IR-fraction was reduced to less than about 0.5 percent in order to prevent falsification of the values when measuring in the UV-range.

31762 (PB—85-157873/XAB) Laser with hollow copper cathode. Lasser, T.; Schetter, K. (Institut Franco-Allemand de Recherches de Saint-Louis, 68 (France)). 14 Nov 1984. 23p. (In German). NTIS, PC E03/MF E03.

Prepared in cooperation with Centre de Documentation de l'Armement, Paris (France). Direction des Recherches, Etudes et Techniques.

The hollow-cathode discharge with its discharge properties and the excitation mechanisms occuring during it forms the foundation for hollow metal cathode lasers. Based on these properties, a hollow copper cathode laser was conceived and investigated experimentally.

31763 (SD-TR—83-92) Pulsed D_2-F_2 chain-laser damage to coated window and mirror components. Amimoto, S.T.; Whittier, J.S.; Whittaker, A.; Chase, A.; Hofland, R. Jr.; Bass, M. (Aerospace Corp., El Segundo, CA (USA). Aerophysics Lab.). 15 Dec 1983. 24p. NTIS, PC A02/MF A01. File Number DE85901412.

Large-spot laser damage thresholds were measured for bowl-feed-polished CaF_2 and sapphire windows (bare and antireflection-coated) and for highly polished copper mirrors (bare and carbyne-coated) at DF chain-laser wavelengths (3.58-4.78 μm). Commercially available antireflection-coated CaF_2 and Al_2O_3 samples were found to have damage thresholds from 17 to 28 J/cm². Significantly larger damage thresholds were observed for uncoated, polished samples of Al_2O_3, but damage resistance of uncoated polished CaF_2 was found to equal that of the best antireflection-coated CaF_2 samples. A highly polished copper mirror had the highest damage threshold of all the materials tested, i.e., 58 J/cm². Carbyne films of diamond-like hardness, a type of carbon coating, were applied to polished copper mirrors and bowl-feed-polished CaF_2 surfaces. The carbyne coatings prepared in this work contained numerous carbon-bearing particles that were easily damaged (~10 J/cm²). However, regions of the irradiated carbyne film that were free of carbon particles withstood high laser fluences (25 J/cm²).

31764 (UCRL—15561-Vol.3) Improved solid state laser sources. Final technical report, September 2, 1982-February 10, 1985. Volume 3. Byer, R.L.; Eckardt, R.C. (Stanford Univ., CA (USA). Dept. of Applied Physics). Apr 1985. Contract W-7405-ENG-48. 17p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85012956.

Investigations have been performed in several areas of solid state laser development. Our research in slab-lasers has resulted in a theory of thermal effects and optical propagation which has allowed scaling to larger slabs and extention of the slab concept to crystalline laser hosts. Our study of nonlinear optical materials has been extended to include $AgGaSe_2$ and Nd:MgO:$LiNbO_3$. $AgGaSe_2$ is useful for nonlinear frequency conversion in the infrared out to 17 microns. Nd:MgO:$LiNbO_3$ allows a single crystal to be used simultaneously as both active laser material and nonlinear optical or modulator material. We have developed a single crystal fiber growth station which has potential application in material surveys by the rapid growth of small samples of crystalline laser materials for spectroscopic evaluation. These research activities combined with other current research programs form a coordinated effort which has resulted in several significant advances in laser development and nonlinear optics.

31765 (UCRL—15627) Investigation of the feasibility of pumping high energy neodymium glass lasers by chemical flashlamps. Final report. Shaffer, J.W. (GTE Sylvania Products Corp., Montoursville, PA (USA)). 18 May 1984. Contract W-7405-ENG-48. 104p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE85012962.

The purpose of the work reported was to determine if chemical reactions in chemical flashlamps could be accelerated to a sufficient degree that the available chemical energy could be radiated in a time comparable to the excited state lifetime of neodymium ions in glass (approximately 350 microseconds), with peak radiation power adequate for producing population inversion in large-aperture Nd-glass laser amplifiers. A second purpose of the work was to estimate the cost of fabrication of the most optimum chemical flashlamps which resulted from this investigation to determine the expected cost-per-shot of a chemical flashlamp pumped system for comparison with xenon flashlamp pumped systems. The work undertaken took two directions: to extend the work employing fluorine-containing oxidizers to higher loadings and shorter times, seeking the maximum peak radiation power; and to investigate the possibility of seeding cyanogen-oxygen combustion with species giving strong radiation in the pump bands of neodymium. (LEW)

31766 (UCRL—15659) **Refractive indices and thermo-optic coefficients of nonlinear crystals isomorphic to KH_2PO_4.** Kirby, K.W.; Hoefer, C.S.; DeShazer, L.G. (Hughes Research Labs., Malibu, CA (USA)). Feb 1985. Contract W-7405-ENG-48. 6p. (CONF-850573—3). NTIS, PC A02/MF A01; GPO Dep. File Number DE85012968.

From Topical conference on basic properties of optical materials; Gaithersburg, MD, USA (7 May 1985).

Refractive indices and their thermal variations were measured for eleven KDP isomorphs. Samples of KDP from different suppliers showed different indices which correlated with observed differences in lattice parameters.

31767 (UCRL—15668) **Photoionization-pumped, Ne II, x-ray laser studies project. Final report.** Richardson, M.C.; Hagelstein, P.L.; Eckart, M.J.; Forsyth, J.M.; Gerrassimenko, M.; Soures, J.M. (Rochester Univ., NY (USA). Lab. for Laser Energetics; Lawrence Livermore National Lab., CA (USA)). 1984. Contract W-7405-ENG-48. 77p. NTIS, PC A05/MF A01; GPO Dep. File Number DE85012973.

The energetics of this pumping scheme are shown. Short-pulse (50 to 100 ps) laser irradiation of an appropriate x-ray flash-lamp medium generates broad-band emission in the range of 300 to 800 eV which preferentially photoionizes Ne to the ^2S state of Ne II creating an inversion at approximately 27 eV. Although this approach does not depend on precise spectral overlap between the x-ray pump radiation and the medium to be pumped, it does require that the x-ray medium remain un-ionized prior to photoionization by the soft x-ray emission. Well-controlled focus conditions are required to ensure that the x-ray medium is not subjected to electron or x-ray preheat prior to irradiation by the soft x-ray source. The magnitude of the population inversion is predicted to be critically dependent upon rapid photoionization of the two states; therefore, ultra-short pulse irradiation of the laser flashlamps is required.

31768 **Cavity supermodes for gain-saturated diode laser arrays.** Hadley, G.R. (Division 1512, Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of Applied Physics;* **58**: No. 1, 97-100(1 Jul 1985).

We present a numerical method for the solution of the cavity modes of a multichannel array of laser diodes. The analysis is based on coupled-mode theory and includes the appropriate boundary conditions for the electric field at each reflecting facet. Saturable gain is also included, with saturation arising from both the forward-going and reflected waves. We present results which differ from a recent analytic analysis for the case of two channels with different gains and propagation constants. The present work predicts "cavity supermodes" which are similar to the "symmetric" and "antisymmetric" waveguide supermodes previously described in the literature. These cavity modes are characterized by equal intensities in both channels even when the channel gains are grossly different.

31769 **Statistical optics applied to high-power glass lasers.** Manes, K.R.; Simmons, W.W. (Lawrence Livermore National Laboratory, P.O. Box 5508, L-493, Livermore, California 94550). *Journal of the Optical Society of America A: Optics and Image Science;* **2**: No. 4, 528-538(Apr 1985). Contract W-7405-ENG-48.

Multiterawatt laser systems, particularly the Novette system at the Lawrence Livermore National Laboratory, are simulated using statistical-optics techniques. The results are compared with experimental observations.

31770 **Mechanism of four-level laser action in solution excimer and excited-state proton-transfer cases.** Khan, A.U.; Kasha, M. (Florida State Univ., Tallahassee). *Proceedings of the National Academy of Sciences of the United States of America;* **80**: 1767-1770(Mar 1983). Contract AS05-78EV05855.

Four-level laser energy level schemes are compared from the mechanistic spectroscopic viewpoint: (1) noble-gas excimer, (2) solution molecular excimer, (3) conventional dye laser, and (4) intramolecular proton transfer. The lasing action of the chlorophyll special pair is discussed as an example of a solution excimer laser, and the lasing action of 3-hydroxyflavone and other molecules is discussed as an example of an intramolecular proton-transfer laser.

4204 Heat Transfer And Fluid Flow

REFER ALSO TO CITATION(S) 29802, 29803, 29804, 29807, 30352, 30671, 30679, 30680, 30696, 30785, 30796, 30797, 30798, 30799, 30801, 30802, 30803, 30805, 30806, 30812, 31039, 31253, 31823, 32391, 32538

31771 (AD-A—151965/1/XAB) **Two-d heat transfer through porous media with heat generation. Master's thesis.** Martinez, B. (Naval Postgraduate School, Monterey, CA (USA)). Jun 1984. 135p. NTIS, PC A07/MF A01.

This thesis investigation develops an axisymmetric heat transfer-combustion model of a porous medium within a circular cylinder. System flow is governed by Darcy's law. Carbon and air properties are treated as variables of temperature. A combined continuity-Darcy equation, an oxygen-mass-balance equation, and energy-balance equations (one each) for air and carbon, describe the conservation laws of the system. Transport mechanisms for oxygen mass transfer are molecular diffusion and convective transport, and an oxygen consumption term to account for combustion is included. Heat-transfer mechanisms included in the model are conduction and convection. Radiation is accounted for at applicable boundaries only. Nonvolatile combustion is accounted for in the carbon energy and oxygen-mass-balance equations as a heat-generation term of Arrhenius type. The numerical solution of four coupled, nonlinear, transient partial differential field equations is accomplished using the Galerkin formulation of the Finite Element Method. The effect of porosity of system behavior is examined.

31772 (AECL—8066) **Numerical computation of phase distribution in two fluid flow using the two-dimensional TOFFEA code.** Carver, M.B. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Aug 1983. 47p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85701482.

A new iterative approach has been developed for multi-dimensional computational analysis of two fluid flow. It has been implemented and tested in a two-dimensional computer code. Parametric surveys are described to illustrate that this code rationally predicts separation of two fluid flows under gravitational and centrifugal influences. Comparisons are made between behaviour computed by the code, and results reported in experimental studies of air and water flowing in elbows and pipes. Plans for extending the code to three dimensions are discussed, as are methods for incorporating an improved model of turbulence.

31773 (DOE/MC/20334—T19) **Study of deposition control using transpiration. Technical progress report.** Louis, J.F.; Kozlu, H. (Massachusetts Inst. of Tech., Cambridge (USA)). May 1985. Contract AC21-83MC20334. 5p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85012799.

As a result of the previous analysis of the data on concentration profiles, we have proceeded with the modeling of particle transport across the transpired turbulent boundary layer by introducing the Schmidt number as a function of the normal distance to the wall. A major problem is to determine how the Schmidt number varies within the boundary layer. Schmidt number is affected by the flow structure as well as the mechanics of aerosols. Our validated model for transpired turbulent boundary layer has shown that eddy sizes are constant across the boundary layer. Therefore, we expect that the Schmidt number should be constant for every particle size in the boundary layer operating with strong blowing except for the region very close to the wall. Based on the above analysis, we expect that these structure differences in the flow will cause a drastic change (i.e., like a step function) of Schmidt number very near the wall. The region close to the wall has to be carefully characterized. For large injection rates, the flow close to the wall is dominated by the injected flow emerging from the porous wall. According to the manufacturer, the porous wall is made of very small beads with a diameter of 6 μ. Therefore the emerging flow has non-uniformity characterized by a maximum length of 6 μ which is appreciably smaller than the particle diameter, i.e., 16 μ. In the region very close to the wall, the Schmidt number associated with the particles is large.

31774 (JAERI-M—83-184) **HEATING5-JR: a finite difference computer program for nonlinear heat conduction problems.** Ikushima, Takeshi; Nakazato, Chikara. (Japan Atomic Energy Research Inst., Tokyo). Nov 1983. 105p. (In Japanese). NTIS (US Sales Only), PC A06/MF A01. File Number DE85701121.

Computer program HEATING5-JR is a revised version of HEATING5 which is a finite difference computer program used for the solution of multi-dimensional, nonlinear heat conduction problems. Pre- and post-processings for graphical representations of input data and calculation results of HEATING5 are avaiable in HEATING5-JR. The calculation equations, program descriptions and user instructions are presented. Several example problems are described in detail to demonstrate the use of the program.

31775 (NASA-TM—83739) **Investigation of the three-dimensional flow field within a transonic fan rotor: experiment and analysis.** Pierzga, M.J.; Wood, J.R. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1984. 26p. (CONF-840611—4; USAAVSCOM-TR—83-C-16). NTIS, PC A03/MF A01. File Number TI85901299.

From International gas turbine conference and exhibit; Amsterdam, Netherlands (4 Jun 1984).

An experimental investigation of the three-dimensional flow field through a low aspect ratio, transonic, axial-flow fan rotor has been conducted using an advanced laser anemometer (LA) system. Laser velocimeter measurements of the rotor flow field at the design operating speed and over a range of through-flow conditions are compared to analytical solutions. The numerical technique used yields the solution to the full, three-dimensional, unsteady Euler equations using an explicit time-marching, finite volume approach. The numerical analysis, when coupled with a simplified boundary layer calculation, generally yields good agreement with the experimental data. The test rotor has an aspect ratio of 1.56, a design total pressure ratio of 1.629 and a tip relative Mach number of 1.38. The high spatial resolution of the LA data matrix (9 radial by 30 axial by 50 blade-to-blade) permits details of the transonic flow field such as shock location, turning distribution and blade loading levels to be investigated and compared to analytical results.

31776 (NUREG/CR—0200-Vol.2, pp vp, Section F10) **HEATING6: a multidimensional heat conduction analysis with the finite-difference formulation.** Elrod, D.C.; Giles, G.E.; Turner, W.D. (Oak Ridge National Lab., TN). Dec 1984. NTIS, PC A99/MF A01. File Number TI85007576. (ORNL/NUREG/CSD—2/Vol.2). Contract W-7405-ENG-26.

In SCALE: a modular code system for performing standardized computer analyses for licensing evaluation. Volume 2. Functional modules.

HEATING6, a modification of the generalized heat conduction code HEATING5, is designed to solve steady-state and/or transient heat conduction problems in one-, two-, or three-dimensional Cartesian or cylindrical coordinates or one-dimensional spherical coordinates. The thermal conductivity, density, and specific heat may be both spatially and temperature-dependent. The thermal conductivity may be anisotropic. Materials may undergo a change of phase. Thermal properties of materials may be extracted from a material properties library. Heat generation rates may be dependent on time, temperature and position, and boundary temperatures may be time- and position-dependent. The boundary conditions, which may be surface-to-boundary or surface-to-surface, may be specified temperatures or any combination of prescribed heat flux, forced convection, natural convection, and radiation. The thermal efficiency of certain finned surfaces may be modeled. The boundary condition parameters may be time- and/or temperature-dependent. The mesh spacing may be variable along each axis. HEATING6 is variably dimensioned and utilizes free-form input. This report includes a discussion of the numerical techniques used by HEATING6, sections on the program structure and modeling concepts, a detailed set of instructions for preparing input data and using the code, and several sample problems.

31777 (NUREG/CR—0200-Vol.2, pp vp, Section F13) **HEATPLOT-S: a temperature distribution plotting program for HEATING5/HEATING6.** Cobb, C.K. (Oak Ridge National Lab., TN). Dec 1984. NTIS, PC A99/MF A01. File Number TI85007576. (ORNL/NUREG/CSD—2/Vol.2).

In SCALE: a modular code system for performing standardized computer analyses for licensing evaluation. Volume 2. Functional modules.

HEATPLOT-S is a temperature distribution plotting program that may be used with the HEATING5 or HEATING6 generalized heat conduction codes. HEATPLOT-S has the capability of generating temperature contours, temperature-time profiles, and temperature-distance profiles from the current HEATING5/HEATING6 temperature distribution or from the temperature changes relative to the initial temperature distribution. Contour plots may be generated for two- or three-dimensional models. Temperature-time and temperature-distance profiles may be generated for one-, two-, or three-dimensional models. HEATPLOT-S uses the DISSPLA (Display Integrated Software System and Plotting Language) graphics package, and generates a compressed plot data set that can be stored on disk or routed to various plotting devices. Subsections are: introduction, input, and sample problem.

31778 (NUREG/CR—0200-Vol.2, pp vp, Section F14) **REGPLOT6: a plotting program to verify HEATING6 input data.** Cobb, C.K. (Oak Ridge National Lab., TN). Dec 1984. NTIS, PC A99/MF A01. File Number TI85007576. (ORNL/NUREG/CSD—2/Vol.2).

In SCALE: a modular code system for performing standardized computer analyses for licensing evaluation. Volume 2. Functional modules.

REGPLOT6 is a plotting program that enables the user of the HEATING6 generalized heat conduction code to graphically verify the accuracy of HEATING6 input data. Maps of the regions, the materials, the heat generation function numbers, the initial temperature function numbers, and the boundary condition function numbers are generated by plotting the region boundaries and labeling each region appropriately. REGPLOT6 uses the DISSPLA (Display Integrated Software System and Plotting Language) graphics package, and generates a compressed plot data set that can be stored on disk or routed to various plotting devices. Subsections are introduction and input/sample problem.

31779 (SAND—84-0878) **PETROS: a program for calculating transport of heat, water, water vapor and air through a porous material.** Hadley, G.R. (Sandia National Labs., Albuquerque, NM (USA)). May 1985. Contract AC04-76DP00789. 68p. NTIS, PC A04/MF A01; GPO Dep. File Number DE85013168.

The one-dimensional code PETROS computes the transport of water, water vapor, an inert gas, and heat through a partially saturated porous medium. The mass flux of liquid water is driven by gradients in saturation, temperature, and gas pressure as well as the force of gravity. Gas transport includes effects due to Knudsen diffusion and binary gaseous diffusion of each gas component, plus Darcy flow of the gas mixture. Evaporation and condensation are accounted for, both in the fluid mass balance and the heat equation. This report includes a description of the model assumptions and the resulting equations, together with the numerical techniques used to obtain problem solutions. Included also are instructions for running the code, and a sample problem. 8 refs.

31780 (UCRL—91617) **Compressible two-phase flow instabilities simulated with a hybrid Lagrange-Euler pseudospectral method.** Buckingham, A.C. (Lawrence Livermore National Lab., CA (USA)). 29 Mar 1985. Contract W-7405-ENG-48. 13p. (CONF-850745—6). NTIS, PC A02/MF A01; GPO Dep. File Number DE85009904.

From 4. international conference on numerical methods in laminar and turbulent flow; Swansea, UK (8 Jul 1985).

A pseudospectral collocation procedure has been developed specifically for studying unsteady, compressible flow instability growth and subsequent random flow states signaling turbulence onset. A mass centered Lagrange moving mesh is used for resolving compressibility and material interfaces. The Lagrange mesh is combined with a fixed Eulerian mesh over which spanwise compo-

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nents are resolved with a spectral transform method. Time evolution is approximated by means of a conventional third-order Runge Kutta procedure. A Rayleigh-Taylor unstable liquid propellant gas vapor interface situation is simulated during the initial growth phase of the perturbation. The influence of super-imposed pressure oscillations on the fuel sheet breakup is examined.

31781 (UCRL—92505) **New semi-implicit method for solving the time-dependent conservation equations for incompressible flow.** Gresho, P.M.; Chan, S.T. (Lawrence Livermore National Lab., CA (USA)). Apr 1985. Contract W-7405-ENG-48. 21p. (CONF-850745—5). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85010926.

From 4. international conference on numerical methods in laminar and turbulent flow; Swansea, UK (8 Jul 1985).

A semi-implicit time integration scheme for the advection-diffusion equation, in which the advection terms are stepped forward in time using explicit Euler and the diffusion terms, which include a truncation error correction term, are integrated via the trapezoid rule, is described and demonstrated. In the extension to the Navier-Stokes and Boussinesq equations, all additional terms are integrated via explicit Euler.

31782 (UFRJ-COPPE-PEN—119) **Rewetting of fuel elements in nuclear reactors-a variational treatment.** Carmo, E.G.D. do; Roberty, N.C.; Oliveira, L.F.S. de; Kinrys, S. (Rio de Janeiro Univ. (Brazil). Coordenacao dos Programas de Pos-graduacao de Engenharia). Feb 1983. 18p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. File Number DE85701483.

A variational formulation for a fuel rod rewetting problem, during a LOCA is presented. This formulation allows to solve the problem for any profile of the Biot number. So, the general formulation of the problem is presented, and an application of the model is done, considering three regions of heat transfer, being the Biot number constant for each region. A iterative procedure was developed to determine the rewetting velocity and the quench-front size. The semi-analytical solution, for all the cases, was obtained by the Ritz method. Some of the results, such as the variation of the quench-front size and the rewetting velocity with the cladding temperature before the reflood and with the inlet coolant temperature are discussed.

31783 **Radiative and convective transfer in a cylindrical enclosure for a real gas.** Smith, T.F.; Shen, Z.F.; Alturki, A.M. (Department of Mechanical Engineering, The University of Iowa, Iowa City, Iowa 52242). *Journal of Heat Transfer;* **107**: No. 2, 482-505(May 1985). Contract AC02-79ER10515.

Heat transfer and temperature distributions are calculated for gas flow in a black wall circular duct. (AIP)

31784 **Heat conduction through layered refractory linings.** Buyukozturk, O.; Tseng, T.M. (Massachusetts Institute of Technology, Cambridge). *Journal of Engineering Mechanics;* **109**: No. 4, 1000-1015(Aug 1983).

A predictive model is developed for transient heat-transfer analysis of structures with layered heterogeneous media. The model is particularly suited for the analysis of refractory-concrete-lined coal-gasification and other similar chemical-processing vessels. To allow for the effects of high-conductivity gases in voids and cracks on the overall conductivity of the media, an effective conductivity model is developed. The model incorporates the effects of temperature-dependent nonlinear material properties. Validity of the model is shown by comparing the predictions with those from an analytical solution for a special case, another numerical solution, and experimental measurements from an actual test vessel. Sensitivity of the temperature distribution to the presence of hydrogen gas in the vessel environment is evaluated. 36 references, 11 figures, 2 tables.

4205 Materials Testing

REFER ALSO TO CITATION(S) 30841, 31036

31785 (BDX—613-3260) **X-ray fluorescence analysis of 304L stainless steel. Final report.** Lantz, L.L. (Allied Corp., Kansas City, MO (USA). Bendix Kansas City Div.). May 1985. Contract AC04-76DP00613. 25p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85013254.

This project was undertaken to develop a faster, more accurate method to determine the composition of 304L vacuum arc remelted (VAR), corrosion resistant steel. An accurately measured composition is required to predict the 304L ferrite content, which must be controlled to produce crack resistant welds. An x-ray fluorescence spectrometry method has been developed for the analysis of 12 elements in 304L steel. The sample composition is calculated using the XRF-11 fundamental parameters computer program (Criss Software, Incorporated, Largo, MD) for x-ray fluorescence analysis. Absolute accuracies within +-0.1 wt % are obtained for chromium and nickel in certified standards analyzed as samples by using program standards having composition close to sample composition and by making matrix corrections for all elements in the standards and samples. A comparison is made of the chromium concentration in 24 304L samples determined by the x-ray method and by wet chemical analysis.

31786 (CEA-CONF—7536) **Synergy effect in accident simulation.** Alba, C.; Carlin, F.; Chenion, J.; Gaussens, G.; Le Meur, M.; Petitjean, M. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete). May 1984. 26p. (In French). (CONF-840516—10; DAS—85). NTIS (US Sales Only), PC A03/MF A01. File Number DE85751316.

From International symposium on aging in tests of safety equipment for nuclear power plants; Paris, France (15 May 1984).

Accidental breaking of PWR coolant canalization would entail water vaporization into confinement enclosure. Equipments would be simultaneously subjected to temperature and pressure increase, chemical spray, and radiation action of reactor core products. Some equipments have to work after accident in order to stop reactor running and blow out water calories. Usually, in France, accident simulation tests are carried out sequentialy: irradiation followed by thermodynamical and chemical tests. Equipments working is essentially due to those polymer materials behaviour. Is the polymers behaviour the same when they are either subjected to sequential test, or an accident (simultaneous action of irradiation and thermodynamical and chemical sequence). In order to answer to this question, nine polymer materials were subjected to simultaneous and sequential test in CESAR cell. Experiments were carried out in CESAR device with thermodynamical chocks and a temperature and pressure decrease profil in presence or without irradiation. So, the test is either simultaneous or sequential. Mechanical properties change are determined for the following polymeric materials. Two polyamide-imide varnishes used in motors and coils; one epoxydic resin, glass fiber charged (electrical insulating); polyphenylene sulfide, glass fiber charged, the Ryton R4 (electrical insulating); three elastomeric materials: Hypalon, fire proof by bromine or by alumina EPDM (cables jacket); VAMAC which is a polyethylene methyl polymethacrylate copolymer; then a silicon thermoset material glass fiber charged (electrical insulating). After test, usually, mechanical and electrical properties change of polymer materials show sequential experiment is more severe than simultaneous test however, Hypalon does not follow this law. For this polymer simultaneous test appears more severe than sequential experiment.

31787 (CSIR-TSD—0009/83, pp vp) **Technological advances at Pelindaba.** De Jesus, A.S.M. (Nuclear Development Corp. of South Africa (Pty.) Ltd., Pelindaba, Pretoria. Radiation Technology Div.). Oct 1983. CSIR, P.O. Box 395, Pretoria, 0001, South Africa. (CONF-8310380—).

From Mini-seminar on non-destructive testing; Pretoria, South Africa (1 Oct 1983).

NUCOR has recently established the Nuclear Techniques Industrial Service (NTIS) with the specific purpose of providing a professional service to industry on a commercial basis. In the article

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some investigations conducted for industry will be briefly described, with neutron radiography as a complementary technique to conventional industrial radiography being dealt with in greater detail. The applications of nuclear technology in industry are very versatile, both in range of applications as well as in the variety of techniques which can be used. It's applications include the following: i) rapid assay of gold purity; behaviour of potassium in a blast furnace; performance of continuous massecuite crystalysers; airflow measurement in mine shafts; monitoring of electrode length in an electrical arc furnace; monitoring of termite damage in wooden utility poles; behaviour of pollutants in the Crocodile river; distribution of boron in steel and in measuring the dynamic behaviour of materials in processing plants.

31788 (CSIR-TSD—0009/83, pp vp) **Standing of industrial radiography in South Africa.** Marais, J.J. (Uniray Technical Services (Pty.) Ltd.). Oct 1983. CSIR, P.O. Box 395, Pretoria, 0001, South Africa. (CONF-8310380—).

From Mini-seminar on non-destructive testing; Pretoria, South Africa (1 Oct 1983).

In this article a look is taken at industrial radiography in South Africa to determine where radiographic testing is being used, and for what reasons. The status of training of industrial radiographers is considered and it is compared to radiographic techniques used in South Africa.

31789 (CSIR-TSD—0009/83, pp vp) **New developments in industrial radiography.** Daker, W.J. (SA X-ray (Pty.) Ltd.). Oct 1983. CSIR, P.O. Box 395, Pretoria, 0001, South Africa. (CONF-8310380—).

From Mini-seminar on non-destructive testing; Pretoria, South Africa (1 Oct 1983).

The article deals with new developments in industrial radiography and also investigates the problem of limiting material thickness of either very thick or very thin materials. Ytterbium 169 has an ideal energy level for the radiography of material thinner than 10mm of steel. It also has an extremely high specific activity. To decide upon the optimum radiation type and energy level it is necessary to consider the imaging method which is to be used. This includes: radiographic films; microfilming; image processing; image manipulation; image enhancement; automatic interpretation; fluorovision; image intensifiers and x-ray videcon cameras.

31790 (CSIR-TSD—0009/83, pp vp) **Flash radiography.** Botten, S.F. (SA X-ray (Pty.) Ltd.). Oct 1983. CSIR, P.O. Box 395, Pretoria, 0001, South Africa. (CONF-8310380—).

From Mini-seminar on non-destructive testing; Pretoria, South Africa (1 Oct 1983).

Flash radiography is a technique of radiography that has been used to a limited degree in South Africa, its users being restricted to ballistics and Research and Development in this field. In flash radiography the object being radiographed is by no means static. In flash radiography the object or event being radiographed, is not only obscured, but it is also in motion at very high speeds or very short duration. An image can only be obtained by a very short duration single pulse of x-rays. The main problem encountered with flash radiography was the production of exposures of very short duration and extremely high output. Specialised x-ray equipment was needed for this.

31791 (CSIR-TSD—0009/83, pp vp) **Basic principles of industrial radiography.** Bestbier, P. (S.A. Bureau of Standards, Western Cape Region). Oct 1983. CSIR, P.O. Box 395, Pretoria, 0001, South Africa. (CONF-8310380—).

From Mini-seminar on non-destructive testing; Pretoria, South Africa (1 Oct 1983).

X-ray radiography and gamma radiography are used in industrial radiography. X-rays and gamma rays have the ability to penetrate materials and be absorbed by different densities. This characteristic makes them useful tools in industrial and medical radiography. The sources used for the generation of x-rays, gamma rays and radioisotopes are discussed. Films are one of the recording methods of x-radiography. The article also deals with advantages and disadvantages of radiography. Factors governing radiation exposure includes: the type of radiation source, material to be radiographed, distance, film, and the method for development. International specifications are also responsible for strict control over the standard of workmanship in industrial radiography.

31792 (CSIR-TSD—0009/83, pp vp) **Radiological safety aspects of industrial radiography.** Hanekom, A.P. (Atomic Energy Board, Pelindaba, Pretoria (South Africa)). Oct 1983. CSIR, P.O. Box 395, Pretoria, 0001, South Africa. (CONF-8310380—).

From Mini-seminar on non-destructive testing; Pretoria, South Africa (1 Oct 1983).

Industrial radiography and especially gamma-radiography, has established itself as a very powerful tool in non-destructive testing. Unfortunately there is an amount of risk attached to the use of industrial radiography. The primary causes of radiography accidents include: working conditions, equipment failure and lack of supervisory control. To alleviate the radiological risks involved with gamma-radiography, the Atomic Energy Corporation (AEC) has imposed various conditions for the possession, use, and conveyance of radioactive material. This includes personnel training and equipment specifications.

31793 **(CSIR-TSD—0009/83) Mini-seminar on non-destructive testing.** (Council for Scientific and Industrial Research, Pretoria (South Africa). Dept. of Technical Services). Oct 1983. 14p. (CONF-8310380—). CSIR, P.O. Box 395, Pretoria, 0001, South Africa.

From Mini-seminar on non-destructive testing; Pretoria, South Africa (1 Oct 1983).

Individual items in scope for the data base are processed separately.

31794 **(DOE/ER/13163—6) Mechanical interactions of rough surfaces. Quarterly progress report, December 31, 1984-March 31, 1985.** McCool, J.I.; Hadden, G.B. (SKF Industries, Inc., King of Prussia, PA (USA)). Mar 1985. Contract AC02-84ER13163. 60p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85010390.

Full film traction test results obtained at various loads and speeds with two oils, two test elements (a ball and roller) and with and without lateral sliding, are presented and discussed. Lubricant properties deduced from the tests performed without lateral sliding were used with the Tevaarwerk-Johnson fluid traction model incorporated within program TRIBOS, to predict the corresponding traction coefficient and traction curve slope in the presence of lateral sliding. Tests designed to infer the asperity Coulomb friction coefficient in the partial film or mixed EHD region are described. Surface roughness parameters obtained by digital processing of the multiple traces made on these disks used in the mixed traction tests are summarized. The criteria that these parameters must satisfy for internal consistency and hence for proper functioning within a microcontact model are derived. Modifications to computer program SKARESIM are described. Methodology for estimating the value of the mean square profile curvature m_4 using the output of a conventional stylus profile instrument is evaluated. Predicted and directly measured values of m_4 are compared and shown to be consistent within sampling error. A procedure is described for assessing via SKARESIM, a criterion which alleges that stylus profile fidelity is acceptable when m_4 does not exceed the inverse of the square of the profile radius.

31795 **(EPRI-NP—3821-SR) Nondestructive evaluation program: progress in 1984.** Dau, G.J.; Behravesh, M.M.; Lapides, M.E.; Liu, S.N.; Oldberg, T.; Quinn, J.R.; Scheibel, J.R.; Viswanathan, R.; Welty, C. (Electric Power Research Inst., Palo Alto, CA (USA). Systems and Materials Dept.). May 1985. 330p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920658.

In 1984 - its tenth year - the EPRI nondestructive evaluation program included initial assessment of a high-speed ultrasonic imaging system for real-time on-site flaw detection and successful demonstration of several advanced BWR pipe inspection systems among its achievements. This year also saw expansion of inspection training and demonstrations of new procedures at EPRI's NDE Center.

31796 **(EUR—8484) Destructive examination of test plates 1 and 2 of the defects detection trials (DDT).** Crutzen, S.; Buegers, W.; Violin, F.; Di Piazza, L.; Cowburn, K.; Sargent, T. (Commission of the European Communities, Luxembourg; Commission of the European Communities, Ispra (Italy). Joint Research Centre). 1984. 48p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85701487.

The evaluation of NDT exercises results has been based on destructive examination of the plates or test blocks used during the exercise. The PISC Programme has shown that in all cases the indications given by the NDT instrumentation were corresponding to some particular defects or structure aspects in the steel or were explained by particular positions of reflectors. Generally the introduction of defects do not produce a final "defective zone or area" which is strictly corresponding to the intended defect. The DDT exercise management has thus decided to perform a complete destructive examination of the four plates involved in this exercise because of its experience (the PISC I exercise) and independance of commercial interest, the JRC of the CEC Ispra Establishment has been asked to do the work with the Risley Nuclear Power Development Laboratories (RNL). The present report describes the results of the destructive examination of the DDT plates 1 and 2.

31797 **(SKI-B—30-78) Dimensions of defects determined by radiographical testing.** Oesterberg, J. (Swedish Nuclear Power Inspectorate, Stockholm; Swedish Plant Inspectorate, Stockholm). [1985]. 24p. (In Swedish). NTIS (US Sales Only), PC A02/MF A01. File Number DE85701239.

Normally industrial radiography using x-rays or radionuclides gives information on the existence of defects in welds. These defects may in some instances be harmless, the size of the flaw is important. Radiography may be used for determining the thickness of the defect in many cases, by measuring the blackening of the photographic film used. The report gives a theoretical treatment of the problems and goes on to practical examples of the application. For flaws that have a width of at least 0.3 mm, a thickness of the order 0.1 mm can be determined with sufficient accuracy in materials 40 mm thick.

31798 **(UCRL—92010-Rev.1) Hopkinson bar simulation using DYNA2D. Revision 1.** Smith, J.A.; Glover, T.A. (Lawrence Livermore National Lab., CA (USA)). 1 May 1985. Contract W-7405-ENG-48. 7p. (CONF-850466—4-Rev.1). NTIS, PC A02/MF A01; GPO Dep. File Number DE85012928.

From 2. symposium on the interaction of non-nuclear munitions with structures; Panama City, FL, USA (15 Apr 1985).

A finite-element simulation of a Split Hopkinson's bar (Kolsky apparatus) technique involving mortar specimens is accomplished with DYNA2D, an explicit two-dimensional finite-element code. Calculations are compared with experimental results contained in a University of Florida report Dynamic Response of Concrete and Concrete Structures, and with analytic solutions of the appropriate wave propagation problem.

4206 Safety Engineering

REFER ALSO TO CITATION(S) 33095

4207 Vacuum Engineering

REFER ALSO TO CITATION(S) 32000, 32073

31799 **Management of vacuum leak-detection processes, calibration, and standards.** Wilson, N.G. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* 3: No. 3, 533-537(May 1985).

Vacuum leak detection requires integrated management action to ensure the successful production of apparatus having required leak tightness. Implementation of properly planned, scheduled, and engineered procedures and test arrangements are an absolute necessity to prevent unexpected, impractical, technically inadequate, or unnecessarily costly incidents in leak-testing operations. The use of standard procedures, leak standards appropriate to the task, and accurate calibration systems or devices is necessary to validate the integrity of any leak-test procedure. In this paper, the need for implementing these practices is discussed using case histories of typical examples of large complex vacuum systems. Aggressive management practices are of primary importance throughout a project's life cycle to ensure the lowest cost; this includes successful leak testing of components. It should be noted that the opinions and conclusions expressed in this paper are those of the author and are not those of the Los Alamos National Laboratory or the Department of Energy.

31800 **Underground remotely controlled cryopump vacuum system utilizing 460-m long helium gas lines.** Karpenko, V.P.; Beat, T.; Wong, K.; Sullenburger, J.; Kountainis, B.; Price, S. (Lawrence Livermore National Laboratory, L-122, Livermore, California 94550). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* 3: No. 3, 1690-1694(May 1985). Contract W-7405-ENG-48.

A 1600 l vacuum chamber buried 300 m underground required a continuous operational vacuum of $<1 \times 10^{-6}$ Torr. Due to physics criteria, high gas load (2×10^{-3} Torr l/s), space limitations, harsh operating environment and reliability requirements, a cryopump vacuum system was designed to meet all design and operational requirements. The vacuum system consisted of downhole and uphole subsystems linked by 460 m long pressurized copper helium gas lines and control cables. The uphole subsystem consisted of the helium compressors, automatic control, and monitoring system. The downhole system consisted of the vacuum pumps and all related supported hardware necessary for long unattended remote operation. The design, installation, and operational requirements are reviewed and summarized for this initial and unusual application of remotely operated cryopumps.

4208 Electronic Circuits And Devices

REFER ALSO TO CITATION(S) 30667, 30687, 31538, 31555, 31978, 31991

31801 **(AD-A—150429/9/XAB) Control of cascaded induction-generator systems. Final technical report, 1 September 1983-30 August 1984.** Ortmeyer, T.H. (Clarkson Coll. of Tech., Potsdam, NY (USA). Dept. of Electrical and Computer Engineering). 13 Dec 1984. 63p. NTIS MF A01.

This report documents an investigation of the stability and control of cascaded doubly fed machines (CDFM). These machines are brushless variable-speed constant-frequency electric power generators with potential for application in aircraft. A previous analytical study indicated the CDFM system would be controllable in the subsynchronous operating mode with a passive RL load. The present study contains two steps. First is an investigation of the machine operation in the supersynchronous mode. The second step is an investigation of machine operation with output capacitors providing excitation VARs for the machine and load. Step 1 results show that the machines exhibit stability characteristics in the supersynchronous mode similar to those observed in the subsynchronous mode. Step 2 results show that output capacitors degrade the system performance, particularly at light loads. The results show that output current feedback can be employed to improve the system performance.

31802 **(AD-A—152059/2/XAB) Manufacturing methods and technology for electromagnetic components. Interim report.** Bunker, E.R.; Arnett, J.R.; Williams, J.L. (Hughes Aircraft Co., Culver City, CA (USA)). Oct 1978. 215p. NTIS, PC A10/MF A01.

The purpose of the present MMandT program is to investigate, evaluate, and implement techniques for the manufacture of low-cost, highly reliable electromagnetic components for missile-systems applications. The emphasis is on implement, through a continuing program to rapidly disseminate this information to electromagnetic component manufacturers with the purpose of assisting them to produce lower-cost, more-reliable products. The basic effort phase of this program, reported in this documented, was concerned with two tasks: improving the manufacturing methods of potting/encapsulation, and investigating the winding techniques of electromagnetic devices. Three remaining tasks, now in process, are: interconnection techniques, tooling, and structural parts, to be covered in a subsequent report. It is anticipated that the combined results of these five tasks will implement improved manufacturing methods for electromagnetic components so that a significant payback in manufacture and life-cycle costs of present and future missile systems, due to lower production costs, higher process yield, and improved reliability will be obtained.

31803 **(BDX—613-3230) Thermally induced failures of thick-film glaze resistors.** Raffety, M.S.; Tuohig, W.D. (Allied Corp., Kansas City, MO (USA). Bendix Kansas City Div.). May 1985. Contract AC04-76DP00613. 20p. (CONF-850599—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE85012014.

From 35. electronics components conference; Washington, DC, USA (20 May 1985).

Thick-film glaze resistors are particularly attractive for use in environments subject to extreme changes in temperature because of their low TCR values. Recently, however, it has been shown these resistors may fail when they are subjected to extended temperature cycling. The failures are characterized by increasing resistance with cycling and may ultimately culminate in a completely open condition. Examination of the failed components using a scanning electron microscope revealed the presence of cracks in the resistive glaze. The microstructural origin and propagation of these cracks are discussed in terms of an elastic model, and solutions to the problem of thermal cycling failure are proposed.

31804 **(CONF-850558—2) Infrared generation and wave-mixing studies in cesium.** Christian, W.; Stockdale, J.A.D.; Dodhy, A.; Compton, R.N. (Oak Ridge National Lab., TN (USA); Davidson Coll., NC (USA)). 1985. Contract AC05-84OR21400. 7p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85012883.

From Conference on lasers and electro-optics; Baltimore, MD, USA (21 May 1985).

A Nd-YAG pumped dye laser and heat pipe has been used to investigate stimulated infrared production, wave mixing, and ionization in cesium vapor near the one-photon resonant 7P/sub 1/2,3/2/ fine structure states.

31805 **(LA-UR—85-1936) Multi-megampere current interruption from explosive deformation of conductors.** Goforth, J.H.; Williams, A.H.; Marsh, S.P. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 5p. (CONF-850616—15). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85012756.

From 5. IEEE pulsed power conference; Washington, DC, USA (10 Jun 1985).

Two approaches for using explosives to interrupt current flowing in solid conductors are described. One concept uses explosives to extrude the switch conductor into thin regions that fuse due to current in the switch. A preliminary scaling law is presented. The second approach employs dielectric jets to sever current carrying conductors. A feasibility experiment and an improved design are described.

31806 **(LA-UR—85-1939) Multi-megampere operation of plasma compression opening switches in planar geometry.** Goforth, J.H.; Erickson, D.J.; Williams, A.H.; Greene, A.E. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 5p. (CONF-850616—14). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85012755.

From 5. IEEE pulsed power conference; Washington, DC, USA (10 Jun 1985).

Experiments are described in which a plasma compression opening switch is used in planar geometry to sharpen the output pulse of an explosive-driven magnetic flux compression generator. Included are data from tests where peak opening switch currents range from 5.7 to 9.3 MA. The switch is used to transfer current to a static low-inductance load ($\sim$10 nH) with an efficiency of 50% or better and a risetime as low as 0.45 μs. Results related to current transfer are interpreted within a simple analytical model.

31807 **(ORAU/IEA—85-3(M)) Electronic information management and productivity.** Sigmon, E.B. (Oak Ridge Associated Universities, Inc., TN (USA)). Apr 1985. Contract AC05-76OR00033. 40p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85013362.

Recent work by other researchers at IEA has developed a technical basis for Schurr's quarter-century-old hypothesis that energy form influences technological progress. Electrification leads to technological advances because its characteristic flexibility and controllability circumvent barriers inherent with other means of delivering energy to processes. Typically, the productivity impacts of electrification occur in two stages: Small gains are realized when the electric technology is directly substituted for the established non-electric technology; larger gains accrue from subsequent reorganization of the production process permitted by the superior flexibility of the electric technology. This report examines electricity's role as an information medium and finds parallels to its role as an energy medium. Electronic information technologies (e.g., robotics and word processing) permit mechanization of complex, low-volume tasks formerly too expensive to mechanize. Yet experts expect the greatest gains to come from subsequent linking of individual electronically-mechanized tasks into an integrated unit in which information barriers between tasks are largely eliminated. Again, the unique flexibility of electricity leads to technological progress.

31808 **(ORNL—6131) Nuclear electromagnetic pulse (EMP) protection manual for emergency broadcast radio stations and Emergency Operations Centers.** Crutcher, R.I.; Buchanan, M.E.; Agouridis, D.C.; Clark, D.B.; Gates, R.P. II. (Oak Ridge National Lab., TN (USA)). Jun 1985. Contract AC05-84OR21400. 485p. NTIS, PC A21/MF A01; 1; GPO Dep. File Number DE85013548.

This document presents the information and data required to provide retrofit electromagnetic pulse (EMP) protection for facilities included in the Federal Emergency Management Agency's protection programs. An introduction and orientation to the FEMA program are provided in Section 1. Sections 2 and 3 cover the generation of EMP and its coupling into systems. Section 4 compares natural lightning and EMP. The EMP hardening approach adopted by FEMA is presented in Section 5. Section 6 covers the protection devices, their characteristics, and applications. The facility life-support equipment protection is presented in Section 7. Sections 8, 9, and 10 cover the facility site survey, the survey report, and the protector installation. Maintenance and testing of EMP protectors are discussed in Section 11.

31809 **(SAND—84-2374C) Application of pulsed power in the simulation of severe natural lightning.** White, R.A. (Sandia National Labs., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 5p. (CONF-850616—13). NTIS, PC A02/MF A01; GPO Dep. File Number DE85012866.

From 5. IEEE pulsed power conference; Washington, DC, USA (10 Jun 1985).

Pulsed-power technology has application in the laboratory simulation of severe natural lightning. Several years of successful lightning simulator operation at this facility have confirmed the value of pulsed-power approaches in safety assessment testing, and for evaluating lightning induced hazards and transient effects. Performance capability examples are presented to substantiate the practicality of using crowbarred Marx impulse generators for lightning simulation testing. Severe, double-pulse, direct-stroke environments with continuing current have been applied to full-size aircraft and a variety of other test items. A typical double-pulse test simulation of severe lightning has a first-current peak in excess of 200 kiloamps, a rise time of about one microsecond, and a half-amplitude pulse width of about 200 microseconds.

31810 **(SAND—84-2513C) Impedance effects on anode formation of microparticles in an electron-beam diode.** Gray, E.W.; Rinehart, L.F. (Sandia National Labs., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 5p. (CONF-850616—9). NTIS, PC A02. File Number DE85012862.

From 5. IEEE pulsed power conference; Washington, DC, USA (10 Jun 1985).

Anode interactions in electron-beam diodes cannot be ignored. A second impedance level in a microsecond-pulse, electron-beam diode with a carbon cathode has been identified. Production of spherical microparticles was also observed. These particles range in size from 0.2 to 60 μm diameter and their dimensions obey the Rossin-Rammler (logarithmic extreme probability) distribution. These particles do not appear to be able to penetrate far enough into the vacuum space to participate in the bipolar flow on a μs time scale. However, they can damage the electrode support structures and cause spurious discharges on subsequent operation. Possible formation mechanisms of the spherical particles are presented.

31811 (SAND—84-2578C) Statistical distribution of breakdown voltages in rep-rate spark gaps. Rinehart, L.F.; Buttram, M.T. (Sandia National Labs., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 16p. (CONF-850616—6). NTIS, PC A02/MF A01; GPO Dep. File Number DE85012813.

From 5. IEEE pulsed power conference; Washington, DC, USA (10 Jun 1985).

We have previously shown the correlation of various breakdown voltage distributions with conditions in a rep-rated spark gap. We now extend this study to include effects of a wider range of rep-rates (up to 120 pps), electrode-gas combinations (brass with SF_6 and argon), and gas temperature. We explain the behavior of some of the distributions in terms of basic gas breakdown processes and identify some mechanisms.

31812 (SAND—84-2638C) Explosive generators for low-cost pulsed power. Cnare, E.; Cowan, M. (Sandia National Labs., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 22p. (CONF-850616—37). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85013436.

From 5. IEEE pulsed power conference; Washington, DC, USA (10 Jun 1985).

A practical application of explosive generators (MCGs) is to provide relatively low cost pulsed power at very high energy and power to explore high risk technology. We have developed a new explosive generator design, which we call the Model 632, with which we are attempting to bring the cost of prime pulsed power to 10^{-3} dollars per joule and 10^{-7} dollars per watt. The design allows the use of inexpensive liquid explosive and attempts to minimize labor costs in construction of the armature and coil. In its first test, which was carried out with only one half of the designed initial energy, the Model 632 produced 18 MJ at 0.85 TW. We discuss the results of the first two tests of the Model 632 explosive generator and project the actual cost of pulse power from this source.

31813 (SAND—85-0132) Moment-method formulation of the cavity-probe aperture antenna. Jarem, J.M. (Sandia National Labs., Albuquerque, NM (USA)). May 1985. Contract AC04-76DP00789. 61p. NTIS, PC A04/MF A01; GPO Dep. File Number DE85013264.

The electromagnetic moment-method formulation which can be used to determine the fields in a cavity-probe aperture-ground-plane antenna is given. The formulation consists of the submatrix equations which describe the aperture fields and the submatrix equations which describe the probe currents. The aperture submatrix is derived using reaction matching and K-space theory, and the probe equations are derived using pulse- and modal-function expansions. A simple numerical example of the probe solution is given. Indications of how to couple the probe and aperture fields are given. A complete listing of the cavity Green's functions is given.

31814 (SAND—85-0632C) Transient two-dimensional simulation of SEU in a CMOS SRAM cell. Fu, J.S.; Axness, C.L.; Weaver, H.T. (Sandia National Labs., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 6p. (CONF-850711—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE85008419.

From 22. annual conference on nuclear and space radiation effects; Monterey, CA, USA (22 Jul 1985).

Two-dimensional transient simulations of cosmic ion strikes on sensitive junctions of a CMOS SRAM have been carried out. The calculations determine time responses for transport variables of the four cross-coupled transistors and reveal the conditions for change of state or upset. 4 refs., 5 figs.

31815 (UCRL—15676) Evaluation and implementation of testability schemes for gate array integrated circuit design. Final report, February 1-September 30, 1984. Current, K.W.; Edwards, F.; Hayano, S. (California Univ., Davis (USA). Dept. of Electrical and Computer Engineering). 8 Mar 1985. Contract W-7405-ENG-48. 57p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85012874.

The research undertaken involved efforts on two distinct testing problems associated with large-scale (LSI) and very-large-scale (VLSI) integrated circuits. One problem concerns the debugging of chip test set-ups. To help correctly establish and debug chip test set-ups, a chip that generates a unique identifying signal on each of its pads could be useful. Such a chip could drive each wiring connection which could then be sampled. The design, realization, and characteristics of such a "tester" chip are discussed. Also, several "design for testability" schemes for chips are summarized and their potential for use in gate array design procedures is discussed. (LEW)

31816 (UCRL—89176) Numerical modeling of objects near a penetrable interface. Miller, E.K.; Burke, G.J. (Lawrence Livermore National Lab., CA (USA)). Nov 1983. Contract W-7405-ENG-48. 14p. (CONF-830811—21). NTIS, PC A02/MF A01; GPO Dep. File Number DE85013269.

From Conference on quantitative NDE; Santa Cruz, CA, USA (7 Aug 1983).

A numerical approach developed specifically for the antenna-interface problem, but which should be applicable to other problems of this type, is the subject of this paper. It originated from the simple numerical procedure of interpolation, with the intention of achieving a more efficient, yet acceptably accurate, solution. An extension has subsequently been developed to include model-based parameter estimation, and has proven to provide both good accuracy and efficiency for the interface fields. The numerical model used for antennas, involving solution of an integral equation by the method of moments, will be outlined first. Then, the techniques used to reduce computation time for evaluating fields near the interface are described with special attention directed to the differences between the reflected and transmitted field characteristics. Results are included to demonstrate the application of this technique in modeling the detection of buried objects.

31817 Virtual-cathode reflex triode for high-power microwave generation. Burkhart, S.C.; Scarpetti, R.D.; Lundberg, R.L. (Electronics Engineering Department, Lawrence Livermore National Laboratory, P. O. Box 808, Livermore, California 94550). *Journal of Applied Physics;* 58: No. 1, 28-36(1 Jul 1985).

Microwave generation by a relativistic electron beam injected through a screen or foil into a cylindrical waveguide is investigated. The electron beam is generated by a field-emission diode with an anode-cathode gap of ~1 cm. The electron density exceeds the space-charge limit for the beam, which forms a virtual cathode inside the waveguide. The instability of the virtual cathode causes oscillations which couple to bunched reflexing electrons trapped in the potential well. Frequency locking between the oscillating virtual cathode and the reflexing electrons is found to generate a much purer, narrowband microwave output. Using diode mismatch to increase the beam impedance is shown numerically to be a useful technique to improve the microwave generation efficiency and spectral purity. The peak conversion efficiency is calculated to be 2.2% at 7 GHz. The numerical results are compared to experimental results, and the agreement is within 8% in frequency and 25% in peak power. Experimentally, we describe the qualitative effects of different cathode materials and dimensions. The anode materials used were screens and foils of various transparencies and thicknesses. Microwave generation efficiency dropped as the mean scattering angle increased with the thicker foils. Also, the increased transparency of fine screens caused an upward frequency shift due to the increased electron density.

31818 **1000-V, 300-ps pulse-generation circuit using silicon avalanche devices.** Benzel, D.M.; Pocha, M.D. (Lawrence Livermore National Laboratory, Livermore, California 94550). *Review of Scientific Instruments;* **56**: No. 7, 1456-1458(Jul 1985). Contract W-7405-ENG-48.

A Marx configured avalanche transistor string and a pulse rise-time peaking diode are used to generate pulses of >1000 V into a 50-Ω load with rise times of less than 300 ps. The trigger delay of this circuit is about 7—10 ns, with jitter <100 ps. This circuit has been used to generate pulses at a repetition rate up to 5 kHz.

31819 **Simple phase-sensitive detector for Wheatstone bridge resistance measurements.** DiBartolomeo, D.; Klems, J.H. (Applied Science Division, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Review of Scientific Instruments;* **56**: No. 5, 755-757(May 1985). Contract AC03-76SF00098.

A simple and economical phase-sensitive detector circuit is described. The circuit, which was developed for use with large-area heat-flow sensors that employ resistance temperature detection, uses a synchronous rectifier driven by a square wave. It is shown that the circuit has good linearity, resolution, and immunity to external and internal noise.

31820 **(BPA—319) Characteristics of artificially contaminated metal oxide surge arresters by equivalent fog method and fog method.** Taniguchi, T.; Shibuya, M.; Takahashi, M.; Yamashita, M. (USDOE Bonneville Power Administration, Portland, OR; Denryoku Chuo Research Foundation (Japan)). Mar 1984. Translation source information not available . 38p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85012565.

The artificial contamination test of a zinc oxide lightning arrester was conducted using a simple equivalent fog test because the fog test facility was not available to the manufacturer. On one hand, the zinc oxide lightning arrester no longer requires series gaps because of the outstanding nonlinear resistance characteristics of the element. Accordingly, it is said to be superior in contamination proof characteristics. It is also said that washing live lines of insulating tubes is possible. Yet, when the outer surface of the insulating tubes of the zinc oxide lightning arrester is contaminated, uneven distribution of electric potential on the surface of the insulating tubes could cause high electric current to flow into local elements resulting in raised temperature of the elements. This could cause the phenomenon known as thermal runaway. This report attempts to solve the above question by testing the zinc oxide lightning arrester in both the equivalent fog test and the fog test and by attempting a quantitative comparison of the two test methods for the purpose of revealing the true nature of contamination of the tested lightning arrester.

4209 Waste Processing Plants And Equipment

31821 **(ERP/MSL—83-39, pp 1-24) Compost production from municipal wastes of Canadian mining towns.** Jongejan, A. (Canada Centre for Mineral and Energy Technology, Ottawa, Ontario). Mar 1983. NTIS (US Sales Only), PC A11/MF A01. File Number DE85701198. (CONF-8205300—).

From Canadian Uranium Producers' Metallurgical committee meeting; Bancroft, Ontario, Canada (19 May 1982).

Also published as report MRP/MSL-81-73.

A summary of results of experiments on composting municipal wastes, and an overview of a type of composting process that could be used in small Canadian mining towns are given. The process is a means of waste disposal designed to produce compost. Compost can be used for the revegetation of mine-mill tailings as its sorptive properties complement the chemical action of inorganic fertilizers. The possibility of using compost instead of peat in water pollution-abatement processes can be considered. Difficulties that can be expected if a windrow composting process is continued during the low ambient-temperatures of Canadian winters can be avoided by storing the garbage-sewage mixture as hydraulically-compacted briquettes. Degradation of the briquettes takes place during mild-temperature periods without producing the foul odors of heaped garbage. A tentative plan for composting plant is presented as an illustration of the applicatin of the experimental results in a practical process. Because the process is a means of waste disposal, costs have to be divided between the municipality and the mining industry.

31822 **(PB—85-157592/XAB) Pilot-test application for ozone/ultraviolet-light reactor for industrial process water. Final report, 23 April 1982-23 April 1983.** Leitis, E.; Zeff, J.D.; Do, H.G. (Westgate Research Corp., Los Angeles, CA (USA)). 30 Aug 1983. 80p. NTIS, PC A05/MF A01.

This report describes a study to demonstrate on a pilot-plant scale the removal of refractory organic contaminants in an industrial wastewater by ozone in the presence of UV light. This program consisted of (1) selecting an industrial facility which has a wastewater containing refractory organic compounds that prevent the reuse of the water, (2) transporting and installing a UV-ozonation plant at the selected facility, (3) analyzing treated and untreated wastewater samples for the organic contaminants, (4) evaluating pilot plant operating parameters such as wastewater flow rate and ozone dosage, and (5) deriving design data and cost projections for a full-scale UV/O_3 wastewater treatment plant. The experimental results indicated that, UV-ozonation could not be carried out economically without breaking the emulsion beforehand. Pretreatment of the wastewater with slaked lime gave a nearly complete (less than 98%) UV/O3 oxidation of the contaminants.

4210 Combustion Systems

REFER ALSO TO CITATION(S) 29720, 29729, 29731, 29732, 29733, 29807, 31716, 31717

31823 **(AD-A—150355/6/XAB) Size and velocity distributions of particles and droplets in spray-combustion systems. Final report, 1 March 1980-15 August 1984.** Hirleman, E.D. (Arizona State Univ., Tempe (USA). Dept. of Mechanical and Aerospace Engineering). 1 Nov 1984. 153p. NTIS, PC A08/MF A01.

This research was concerned with laser/optical techniques for size and velocity measurements of particles and droplets in spray-combustion systems. The initial efforts were directed toward a novel method for simultaneous size and velocity measurements of individual particles. A prototype instrument was designed, constructed, calibrated, and successfully applied. Our efforts to verify the performance and accuracy of this diagnostic led to a parallel research effort on the laser diffraction droplet sizing technique. Significant contributions to the calibration and scattering inversion aspects of this technique were made. Contributions to the problem of aerosol characterizations are discussed. Among the papers included in this final report are: Integral Transform for Particle sizing by Near-forward Light Scattering; Non-intrusive Laser-based Particle Diagnostics; Particle Sizing by Optical; Nonimaging techniques; Response Characteristics of Laser Diffraction Size Analyzers--Optical sample volume extent and lens effects; Single Beam Laser Velocimetry in Turbulent Flows; Response Characteristics of the Multiple-ratio, Single-particle Counter; and Developments in Non-Doppler Laser Velocimetry.

31824 **(AD-A—150530/4/XAB) Tests of turbulators for fire-tube boilers. Final report, 29 September 1981-31 December 1982.** Junkhan, G.H.; Bergles, A.E.; Nirmalan, V.; Ravigururajan, T. (Iowa State Univ. of Science and Technology, Ames (USA). Heat Transfer Lab.). Oct 1982. 82p. (HTL—29). NTIS, PC A05/MF A01.

Heat transfer coefficients and friction factors were obtained for three turbulator inserts used in fire-tube boilers. An electrically heated flow facility was developed to deliver hot air to a water-cooled steel tube of 2.675-in. i.d. and 71-3/4 in. length. Tube wall temperatures, fluid bulk temperatures, and flow rates were measured. The cooling coil was segmented so that sectional average heat-transfer coefficients could be derived for four regions of the tube. Reference data for the empty tube are in excellent agreement with the usual correlations. Two commerical turbulators, consisting of narrow, thin-metal strips bent and twisted in zig-zag fashion to allow periodic contact with the tube wall, displayed 125 and 157%

increases in heat-transfer coefficients at a Reynolds number of 10,700. Insert orientation had at most a 10% effect on the heat transfer coefficient. A third commercial turbulator, consisting of a twisted strip with width slightly less than tube diameter, provided a 60% increase in heat transfer coefficient. The friction factor increases accompanying these heat transfer coefficient increases were 1110%, 1000%, and 122%, respectively. These data should be helpful in assessing the overall performance gains to be expected when the turbulators are used in actual boilers.

31825 **(AD-A—150593/2/XAB) Initiation, stability, and limits of detonation for advanced stable air-breathing and hybrid-propulsion engine design. Final report, 15 March 1982-14 March 1983.** Wagner, H.G.; Jost, W. (Goettingen Univ. (Germany, F.R.). Inst. fuer Physikalische Chemie). 15 May 1983. 29p. NTIS, PC A03/MF A01.

The influence of orifices on the propagation of flames in tubes was investigated by measuring flame speeds and pressure on both sides of the orifice and by taking smear-camera pictures of the flames passing through the orifice. In addition, the jet-ignition process was stimulated by igniting high speed jets of turbulent unburned gas with electric sparks. Pressure-time profiles and smear-camera pictures give information about the flame speed in gases with very high degrees of turbulence.

31826 **(AD-A—151505/5/XAB) Asymptotic methods especially in combustion. Final report, 15 June 1981-30 September 1984.** Ludford, G.S.S. (Cornell Univ., Ithaca, NY (USA)). Nov 1984. 10p. NTIS, PC A02/MF A01.

Modern asymptotic methods have been applied to a wide range of problems in combustion science as well as certain magnetohydrodynamic and fluid-mechanical questions. Details are contained in the 49 technical reports and 4 Ph.D. theses listed. Topics covered under this contract included: asymptotic methods, combustion, DDT(deflagration to detonation transition) near-stoichiometry, premixed and diffusion flames, droplet burning, stretch resistance, strain effects, effect of pressure variations, dissociation, non-dilute mixtures, wrinkled flames, burner flames, stability, quenching, heat loss, ignition and extinction, Chapman-Jouget limit, polyhedral flames, surface equilibrium, monopropellant, reactive atmosphere, stagnation-point flow, galloping detonations, flame bubbles, solidification fronts, Hartmann layers, intumescent paints, and flickering.

31827 **(AD-A—151814/1/XAB) Design of a Mobile Combustion Diagnostic Fixture (MCDF). Final report.** Devynck, D. (Army Armament Research and Development Command, Aberdeen Proving Ground, MD (USA). Ballistics Research Lab.). Nov 1984. 51p. (BRL-MR—3412). NTIS, PC A04/MF A01.

A Mobile Combustion Diagnostic Fixture (MCDF) was designed. This fixture is intended to be used in connection with chemical-diagnostic techniques in order to provide data on the phenomena involved in the ignition process of the propelling charge in a gun. Special care was taken of the safety of operation of the fixture.

31828 **(LUTKDH/TKKA—7002/1-28/(1982)) Sound propagation in boilers and heat exchangers equipped with sonic sootblowing.** Werthajm, M. (Lund Inst. of Technology (Sweden). Dept. of Chemical Engineering). Sep 1982. 32p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. File Number DE85750830.

The objective of this report is investigation of sound propagation in boilers when the sootblowing by audible sound is used. Sound is generated by means of pneumatic horns operating at 220-370 Hz and 145 dB at 1 m. Sound pressure level and frequency spectrum have been measured at different places in boiler by means of a special probe designed for high temperature. Measurements are discussed and compared with some theoretical models for sound propagation. Method for calculation of corrections for ambient temperature and pressure, as well as the location and acoustical properties of sound source are performed.

31829 **(NASA/CR—3803) Critical review of noise production models for turbulent, gas-fueled burners.** Mahan, J.R. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA)). Jun 1984. 55p. NTIS, PC A04/MF A01. File Number DE85901308.

A critical review of the combustion noise literature is presented for the period between 1952 and early 1984. The extensive body of literature dealing with feedback-supported combustion oscillations is excluded, as are papers treating all forms of indirect combustion noise, such as entropy noise. Primary emphasis is placed on past theoretical and semi-empirical attempts to predict or explain observed direct combustion noise characteristics of turbulent, gas-fueled burners; works involving liquid-fueled burners are reviewed only when ideas equally applicable to gas-fueled burners are presented. The historical development of the most important contemporary direct combustion noise theories is traced, and the theories themselves are compared and criticized. While most theories explain combustion noise production by turbulent flames in terms of randomly distributed acoustic monopoles produced by turbulent mixing of products and reactants, none are able to predict the sound pressure in the acoustic farfield of a practical burner. The main reason for this failure is the lack of a proven model which relates the combustion noise source strength at a given frequency to the design and operating parameters of the burner. Specific recommendations are given for establishing a benchmark-quality data base needed to support the development of such a model.

31830 **(PB—85-172393/XAB) Application of DRASC method on snecma centers.** (Office National d'Etudes et de Recherches Aerospatiales (ONERA), 92 - Chatillon (France)). 22 Oct 1984. 32p. (In French). NTIS, PC E04/MF E04.

Sponsored by Centre de Documentation de l'Armement, Paris (France). Direction des Recherches, Etudes et Techniques.

ONERA is developing the Raman Anti-Stokes Coherent Diffusion, which makes it possible to make temperature and concentration measurements within flames. This method has already been validated in the case of furnaces or laboratory flames. This test series was the second attempt at using DRASC on a center representative of a combustion chamber in a turboreactor.

31831 **(PB—85-172401/XAB) Behavior of the porous bed in a combustion-deflagration-detonation transition.** Samirant, M.; Lichtenberger, A. (Institut Franco-Allemand de Recherches de Saint-Louis, 68 (France)). 10 Sep 1984. 18p. (In French). (ISL-CO—220/84). NTIS, PC E03/MF E03.

Sponsored by Centre de Documentation de l'Armement, Paris (France). Direction des Recherches, Etudes et Techniques.

This is a follow-up to the conference presented at the 9th DEA Meeting at Unterluess, on the study of the transition combustion-deflagration-detonation in a strongly confined reactive porous medium. The authors review the experimental conditions and the measures taken, as well as the two transition modes observed, one in hexowax, the other in ball powder. They describe for the latter case a special study of the compression of the porous bed.

31832 **(PB—85-176170/XAB) Advanced furnace concepts - commercial unit heater. Annual report, October 1983-September 1984.** Gotterba, J.A.; Schreiber, R.J.; Kesselring, J.P. (Alzeta Corp., Mountain View, CA (USA)). Oct 1984. 101p. (REPT—84-702-110). NTIS, PC A06/MF A01.

See also PB84-179738.

The second year of this planned 2.5-year project was completed. Progress on the first year of the project was described in GRI report 83/0063. The project's objective is to develop an advanced, condensing commercial warm air furnace, or unit heater. The heater will use a gas-fired, low-NOx infrared fiber burner manufactured by the performing organization. In the first of three project phases, it was shown that the retrofit of the burner into a conventional heater resulted in a significant reduction in NOx emissions and noise output. During the second phase, it was determined that a field retrofit of a condensing heat exchanger onto a conventional furnace would not be cost-effective. A prototype of the advanced condensing furnace was then field-tested during the 1983-84 heating season in an industrial plant in Cleveland, Ohio. Significant fuel savings were noted by the user, and the experience gained was applied to the design of the advanced heaters to be tested in Phase 3. Four of these heaters were designed during the Summer of 1984, and fabrication was scheduled for completion in September. Four potential field-test sites in the East and Midwest were identified. Phase 3 will be completed after field testing during the 1984-85 heating season.

4220 Underground Engineering

REFER ALSO TO CITATION(S) 29614, 29615, 29927, 32051

4250 Power Cycles

REFER ALSO TO CITATION(S) 30652, 31285, 31559

31833 **(DTH-LET-RE—83-5) Exergy analyses, aspects of their practical use.** Nielsen, F. (Danmarks Tekniske Hojskole, Lyngby. Lab. for Energiteknik). May 1983. 250p. NTIS (US Sales Only), PC A11/MF A01. File Number DE85750805.

Exergy analyses are a logical and pedagogical thermodynamic tool, which may be used when analyzing and improving the primary energy use of processes. The exergy is defined and the theoretical interpretation and practical application of exergy analyses are discussed. In this connection difficulties, which appear in the practical application of exergy analyses, are described. One difficulty concerns exergy losses, which may be equal in magnitude but very different in character. The characterization of thermal exergy losses is illustrated on two- and five- stage desalination plants. The second of the difficulties in the practical application of exergy analyses, concerns relations between the exergy content of a product and its price. Especially the use of the exergy concept in connection with the distribution of costs of production in cogeneration heat and power plants, which is a common economic problem, is treated. The third of the difficulties in the practical application of exergy analyses, concerns network interactions in process plants. Especially the specific energy- and exergy use of the plant are considered during the parametric changes. The distribution of exergy losses in three semireversible thermodynamic processes at different efficiencies are studied (Carnot-engines and -refrigerators and closed Brayton cycles).

43 PARTICLE ACCELERATORS

4301 Design, Development, And Operation

REFER ALSO TO CITATION(S) 31976

31834 **(CONF-850504—115) Beam intensity increases at the intense pulsed neutron source accelerator.** Potts, C.; Brumwell, F.; Norem, J.; Rauchas, A.; Stipp, V.; Volk, G. (Argonne National Lab., IL (USA)). 1985. Contract W-31-109-ENG-38. 3p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85012377.

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

The Intense Pulsed Neutron Source (IPNS) accelerator system has managed a 40% increase in time average beam current over the last two years. Currents of up to 15.6μA (3.25 x 10^{12} protons at 30 Hz) have been successfully accelerated and cleanly extracted. Our high current operation demands low loss beam handling to permit hands-on maintenance. Synchrotron beam handling efficiencies of 90% are routine. A new H^- ion source which was installed in March of 1983 offered the opportunity to get above 8 μA but an instability caused unacceptable losses when attempting to operate at 10 μA and above. Simple techniques to control the instabilities were introduced and have worked well. These techniques are discussed below. Other improvements in the regulation of various power supplies have provided greatly improved low energy orbit stability and contributed substantially to the increased beam current.

31835 **(FNAL/C—85/59) Tests of orbital dynamics using the Tevatron.** Edwards, D.A.; Johnson, R.P.; Willeke, F. (Fermi National Accelerator Lab., Batavia, IL (USA); Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Apr 1985. Contract AC02-76CH03000. 9p. (CONF-8503105—5). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85012296.

From Orbital dynamics and applications to accelerators workshop; Berkeley, CA, USA (7 Mar 1985).

Measurements of Tevatron beam behavior relevant to questions of orbital dynamics are described. General techniques and some preliminary results from phase space distortion experiments are presented. 3 refs., 7 figs.

31836 **(IFVE-OUNK—83-120) IHEP accelerating and storage complex (UNK) status.** Balbekov, V.I.; Dmitrevsky, Yu.P.; Dunaitsev, A.F. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1983. 23p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85701059.

The modifications introduced into the accelerating and storage complex (UNK) project due to changes in the ring site during constructing the tunnel underground are described. The results obtained from simulating the UNK basic systems: superconducting and iron magnets of the accelerating system are presented. Nowadays designing the UNK equipment buildings forthe process equipment and those for the UNK power supply units is being terminated. The simulation of the UNK basic elements is being carried out. The beam station at the 200 MHz frequency is under construction. Cryogenic equipment has been simulated and tested. For production of the UNK superconducting elements specialized workshops, including automated equipment for testing and calibration are being constructed. Geological surveying and works on selecting an optimum tunnel location with account for the actual geological layers are nearing the end. Consruction of the southern part of the tunnel is in a preparatory stage, access roads are under construction.

31837 **(INIS-mf—9428) Accelerators and alternative nuclear fuel management options.** Harms, A.A. (McMaster Univ., Hamilton, Ontario (Canada)). 1983. 31p. (CONF-8306262—4). NTIS (US Sales Only), PC A03/MF A01. File Number DE85780938.

From Belgian Nuclear Society annual meeting on advanced uses of accelerators on the nuclear fuel cycle; Brussels, Belgium (13 Jun 1983).

The development of special accelerators suggests the potential for new directions in nuclear energy systems evolution. Such directions point towards a more acceptable form of nuclear energy by reason of the consequent accessibility of enhanced fuel management choices. Essential and specifically directed research and development activity needs to be under taken in order to clarify and resolve a number of technical issues.

31838 **(IPNO-GEPL—83-04) Superconducting coils electromagnet of the Orsay IPN project.** Lafoux, A. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). 1983. 51p. (In French). NTIS (US Sales Only), PC A04/MF A01. File Number DE85751296.

This report describes the K 600 superconducting coils magnet of the cyclotron projected at Orsay. It explains the calculation methods and gives the results. The magnet original characteristics give the possibility to accelerate both protons and heavy ions.

31839 **(JAERI-M—84-032) 2 MeV, 60 kW dual-beam type electron accelerator irradiation facility.** Yotsumoto, Keiichi; Kanazawa, Takao; Haruyama, Yasuyuki; Agematsu, Takashi; Mizuhashi, Kiyoshi; Sunaga, Hiromi; Washino, Masamitsu; Tamura, Naoyuki. (Japan Atomic Energy Research Inst., Tokyo). Feb 1984. 127p. (In Japanese). NTIS (US Sales Only), PC A07/MF A01. File Number DE85701060.

The specification of new irradiation facility which has been constructed from 1978 through 1981 as the replacement of 1st Accelerator of JAERI, TRCRE are described. The accelerator is the Cockcroft-Walton type and both vertical and horizontal accelerating tubes are arranged on a single high voltage generator. Transferring of the high voltage to the horizontal accelerating tube is performed with the high voltage changing system in the pressure vessel. The output ratings of the accelerator are 2 MV of acceleration voltage and 30 mA of beam current. By providing the dual beam system, two irradiation rooms, one for vertical and the other for horizontal beam, are independently operationable. Persons can enter the horizontal irradiation room for experimental setting even when the vertical irradiation room is in operation. The specification of the buildings, the exhaust air treatment system, the irradiation conveyor and the safety observation system are also described.

31840 (KEK—82-14, pp 226-228) **Conceptual design of the double-sided microton.** Hayakawa, K.; Tsukada, K.; Sato, K.; Tanaka, T. (Nihon Univ., Tokyo. Atomic Energy Research Inst.). Jan 1983. (In Japanese). NTIS (US Sales Only), PC A11/MF A01. File Number DE85781031. (CONF-8208206—Summ.).

From 7. meeting on linear accelerators; Oho, Ibaraki, Japan (24 Aug 1982).

Published in summary form only.

31841 (KEK—82-14, pp 1-4) **Present status of the 500-MeV electron linac and the 600-MeV storage ring at Electrotechnical Laboratory (ETL).** Tomimasu, T.; Noguchi, T.; Sugiyama, S.; Yamazaki, T.; Mikado, T.; Chiwaki, M. (Electrotechnical Lab., Sakura, Ibaraki (Japan)). Jan 1983. (In Japanese). NTIS (US Sales Only), PC A11/MF A01. File Number DE85781031. (CONF-8208206—Summ.).

From 7. meeting on linear accelerators; Oho, Ibaraki, Japan (24 Aug 1982).

Published in summary form only.

31842 (KEK—82-14, pp 5-7) **Present status of the 35 MeV linac at N.E.R.L. Univ. of Tokyo.** Tabata, Y.; Kobayashi, H.; Ueda, T.; Kobayashi, T.; Washio, M. (Tokyo Univ. (Japan). Faculty of Engineering); Tagawa, S. Jan 1983. (In Japanese). NTIS (US Sales Only), PC A11/MF A01. File Number DE85781031. (CONF-8208206—Summ.).

From 7. meeting on linear accelerators; Oho, Ibaraki, Japan (24 Aug 1982).

Published in summary form only.

31843 (KEK—82-14, pp 8-10) **Present status of the JAERI linac.** Kawarasaki, Y.; Mashiko, K.; Akiyama, N.; Nobusaka, Y.; Shoji, T.; Kitajima, M. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Jan 1983. (In Japanese). NTIS (US Sales Only), PC A11/MF A01. File Number DE85781031. (CONF-8208206—Summ.).

From 7. meeting on linear accelerators; Oho, Ibaraki, Japan (24 Aug 1982).

Published in summary form only.

31844 (KEK—82-14, pp 11-13) **Status report on the variable frequency heavy-ion linac, RILAC.** Odera, M. (Institute of Physical and Chemical Research, Wako, Saitama (Japan)). Jan 1983. (In Japanese). NTIS (US Sales Only), PC A11/MF A01. File Number DE85781031. (CONF-8208206—Summ.).

From 7. meeting on linear accelerators; Oho, Ibaraki, Japan (24 Aug 1982).

Published in summary form only.

31845 (KEK—82-14, pp 14-16) **Status of polarized proton preinjector project.** Fukumoto, S.; Igarashi, Z.; Ikegami, K.; Kato, T.; Kubota, C.; Mori, Y.; Takasaki, E.; Takenaka, T.; Takagi, A. (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)). Jan 1983. (In Japanese). NTIS (US Sales Only), PC A11/MF A01. File Number DE85781031. (CONF-8208206—Summ.).

From 7. meeting on linear accelerators; Oho, Ibaraki, Japan (24 Aug 1982).

Published in summary form only.

31846 (KEK—82-14, pp 17-19) **Present status of the 38 MeV Osaka University Electron Linac.** Tsumori, K.; Yamamoto, T.; Hori, T.; Kimura, N.; Takeda, S.; Okuma, J.; Sawai, T.; Kawanishi, M. (Osaka Univ., Suita (Japan). Inst. of Scientific and Industrial Research). Jan 1983. (In Japanese). NTIS (US Sales Only), PC A11/MF A01. File Number DE85781031. (CONF-8208206—Summ.).

From 7. meeting on linear accelerators; Oho, Ibaraki, Japan (24 Aug 1982).

Published in summary form only.

31847 (KEK—82-14, pp 20-22) **Present status of INS injector linac.** Tojyo, E.; Arai, S.; Kobayashi, K.; Yoshida, K. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Jan 1983. (In Japanese). NTIS (US Sales Only), PC A11/MF A01. File Number DE85781031. (CONF-8208206—Summ.).

From 7. meeting on linear accelerators; Oho, Ibaraki, Japan (24 Aug 1982).

Published in summary form only.

31848 (KEK—82-14, pp 23-25) **Construction of the microtron at Nihon University.** Sato, K.; Tsukada, K.; Hayakawa, K.; Tanaka, T.; Ozaki, T.; Nakamura, N.; Okamoto, K.; Takeda, O.; Nishinaka, M. (Nihon Univ., Tokyo. Atomic Energy Research Inst.). Jan 1983. (In Japanese). NTIS (US Sales Only), PC A11/MF A01. File Number DE85781031. (CONF-8208206—Summ.).

From 7. meeting on linear accelerators; Oho, Ibaraki, Japan (24 Aug 1982).

Published in summary form only.

31849 (KEK—82-14, pp 26-28) **Present status of the 45 MeV electron linac of Hokkaido University.** Tanida, H.; Satoh, K.; Enoto, T.; Ozawa, Y. (Hokkaido Univ., Sapporo (Japan). Faculty of Engineering). Jan 1983. (In Japanese). NTIS (US Sales Only), PC A11/MF A01. File Number DE85781031. (CONF-8208206—Summ.).

From 7. meeting on linear accelerators; Oho, Ibaraki, Japan (24 Aug 1982).

Published in summary form only.

31850 (KEK—82-14, pp 42-46) **Development of a 150 MW S-band klystron.** Anami, S. (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)). Jan 1983. (In Japanese). NTIS (US Sales Only), PC A11/MF A01. File Number DE85781031. (CONF-8208206—Summ.).

From 7. meeting on linear accelerators; Oho, Ibaraki, Japan (24 Aug 1982).

Published in summary form only.

31851 (KEK—82-14, pp 47-51) **Photon factory 2.5 GeV electron linac.** Tanaka, Jiro (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)). Jan 1983. (In Japanese). NTIS (US Sales Only), PC A11/MF A01. File Number DE85781031. (CONF-8208206—Summ.).

From 7. meeting on linear accelerators; Oho, Ibaraki, Japan (24 Aug 1982).

Published in summary form only.

31852 (KEK—82-14, pp 56-60) **PF 2.5 GeV linac accelerator unit assembly and alignment.** Iino, Y.; Asaba, J.; Fujiwara, S.; Tagawa, Y.; Igarashi, H. (Mitsubishi Heavy Industries Ltd., Tokyo (Japan)); Matsumoto, H.; Satoh, I. Jan 1983. (In Japanese). NTIS (US Sales Only), PC A11/MF A01. File Number DE85781031. (CONF-8208206—Summ.).

From 7. meeting on linear accelerators; Oho, Ibaraki, Japan (24 Aug 1982).

Published in summary form only.

31853 (KEK—82-14, pp 81-83) **Progress in medical and industrial electron linear accelerator technology.** Tanabe, Eiji (Varian Associates, Palo Alto, CA (USA)). Jan 1983. NTIS (US Sales Only), PC A11/MF A01. File Number DE85781031. (CONF-8208206—Summ.).

From 7. meeting on linear accelerators; Oho, Ibaraki, Japan (24 Aug 1982).

Published in summary form only.

31854 (KEK—82-14, pp 110-114) **80 MeV injector linac for BSF future project.** Inagaki, S.; Baba, H.; Miki, M.; Sasaki, H. (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)). Jan 1983. (In Japanese). NTIS (US Sales Only), PC A11/MF A01. File Number DE85781031. (CONF-8208206—Summ.).

From 7. meeting on linear accelerators; Oho, Ibaraki, Japan (24 Aug 1982).

Published in summary form only.

31855 (KEK—82-14, pp 129-131) **Acceleration test on the INS RFQ linac 'LITL'.** Ueda, N.; Arai, S.; Nakanishi, T. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Jan 1983. (In Japanese). NTIS (US Sales Only), PC A11/MF A01. File Number DE85781031. (CONF-8208206—Summ.).

From 7. meeting on linear accelerators; Oho, Ibaraki, Japan (24 Aug 1982).

Published in summary form only.

31856 **(KEK—82-14) Proceedings of the 7th meeting on linear accelerators.** Asami, Akira; Sato, Isamu; Fukumoto, Sadayoshi (eds.). (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)). Jan 1983. 255p. (In Japanese). (CONF-8208206—Summ.). NTIS (US Sales Only), PC A11/MF A01. File Number DE85781031.

From 7. meeting on linear accelerators; Oho, Ibaraki, Japan (24 Aug 1982).

Published in smmary form only.

Abstracts of individual items from the meeting were prepared separately for the data base. (GHT)

31857 (KIYI—83-15, pp 10-13) **Automatic system for acquisition of data on the power supply conditions for the cyclotron U-240 magnet.** Linev, A.F.; Sakhno, V.I.; Sokolova, N.A. 1983. (In Russian). NTIS (US Sales Only), PC A03/MF A01. File Number DE85780968.

In Modernization of the U-240 isochronous cyclotron in 1982.

Peculiarities of the automatic data acquisition system developed for the U-240 multipurpose isochronous cyclotron are shown. The system constructed on the basis of commercial digital voltmetets, an "Ehlektronika-60 M" microcomputer and a limited set of specially devised devices (analogue commutators of high accuracy, interface) ensures collection of imformation on 32 parameters of the accelerator. The accuracy is determined by the digital voltmeters used and makes up 0.02-0.003% at the system output speed equal to approximately 4 measurements for second. The general algorithms of the operation are given. The system is realized in the form of a rack whereas the devices incorporated in the rack use the constructive features of the "Vishnya" rack.

31858 (KIYI—83-15, pp 14-19) **Operation of U-240 cyclotron in 1982.** Malofeev, A.I.; Ol'khovskij, K.I.; Pashin, V.A. 1983. (In Russian). NTIS (US Sales Only), PC A03/MF A01. File Number DE85780968.

In Modernization of the U-240 isochronous cyclotron in 1982.

In 1982 the cyclotron operated on a round-the-clock basis with a working period of 136 hrs per week. The total time of users constituted 3740 hrs per year. Distribution of the time planned for the cyclotron operation and distribution of the time between different regimes of proton-, deuteron- and alpha-particle acceleration are presented in tables. The analysis of the main emergency downtimes of the cyclotron is made. A new radial source of light and heavy ions was installed and accelerated carbon ions were obtained. Work on modernization of the V4-generator equipment, power supply, current stabilization system, desalted waster production and equipment water-cooling systems were conducted. Using the U-240 cyclotron the first batches of radioactive isotopes of iodine and other elements for medical purposes were obtained.

31859 (KIYI—83-15, pp 24-30) **Study of peculiarities of conducting the time-of-flight experiments on U-240 cyclotron.** Kolotyj, V.V.; Isaev, A.G.; Kisurin, K.K.; Maksimov, Yu.K.; Pashin, V.A. 1983. (In Russian). NTIS (US Sales Only), PC A03/MF A01. File Number DE85780968.

In Modernization of the U-240 isochronous cyclotron in 1982.

To realize the time-of-flight experiments the time-dependent and structural peculiarities of accelerated particle beams have been investigated. Different ways to obtain time signals unambiguously connected with the ion clusters, that generate neutrons, are considered and investigated. It is shown experimentally that the entrance of particles from several orbits to the outgoing system is possible, and, due to the difference in energies, they will get to the target with a shift in time. Investigations of the time characteristics of the beams have shown that, even without introduction of the phase correction system, it is possible to obtain the time duration of a ion cluster 1.5 ns, whereas the use of the phase autotuning system can ensure the microcluster duration up to 1 ns and the duration of a neutron pulse, respectively.

31860 **(KIYI—83-15) Modernization of the U-240 isochronous cyclotron in 1982.** (AN Ukrainskoj SSR, Kiev. Inst. Yadernykh Issledovanij). 1983. 40p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. File Number DE85780968.

Individual papers are indexed separately.

31861 **(LA-UR—85-1352) Particle-in-cell simulations of the lasertron.** Jones, M.E.; Peter, W.K. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 4p. (CONF-850504—114). NTIS, PC A02. File Number DE85012698.

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

The lasertron is a device (either rf or dc) for producing intense, very short, pulsed electron beams (tens of picoseconds). In the dc lasertron, a laser is pulsed repetitively onto a photoemissive cathode. In general, the current is not space-charge limited and follows the laser intensity. The electron pulse is then accelerated out of the device by a constant voltage. By using the laser the need for a subharmonic buncher is eliminated. In the rf lasertron, the diode becomes an rf cavity. This improves the breakdown characteristics of the device, allowing higher voltages to be applied and hence higher currents to be obtained. The calculations are aimed at producing a 10 nC electron beam with an emittance of less than 40π mm-mrad for use in free-electron laser experiments at Los Alamos. Other applications of the lasertron include efficient microwave or rf generation. A class of electrode shapes has been obtained which in the absence of space charge produces no emittance growth. These shapes have been studied with the particle-in-cell simulation model ISIS, and the electrodes which produce minimum emittance including the effect of space charge have been determined. Unique emittance problems associated with the time dependence of the beam pulse are studied and conditions for reducing these effects are discussed. 5 refs., 5 figs.

31862 **(LA-UR—85-1617) Beam-cavity interaction measurements in a DAW structure.** Iwashita, Y.; Schriber, S.O.; Potter, J.M.; Swenson, D.A.; Mavrogenes, G.S. (Los Alamos National Lab., NM (USA); Texas Accelerator Center, The Woodlands; Argonne National Lab., IL (USA); Kyoto Univ. (Japan). Inst. for Chemical Research). 1985. Contract W-7405-ENG-36. 4p. (CONF-850504—56). NTIS, PC A02/MF A01; GPO Dep. File Number DE85012660.

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

Mode excitations induced by relativistic electron beams have been measured in a disk-and-washer (DAW) structure. The structure had three washers, each with four radial support stems, and half-disk end terminations. The design DAW operating frequency was 1300 MHz, the same as that used to accelerate the electron beam. Both short-pulse (35-ps, 800-Hz, 17-nC/pulse) and long-pulse (10-μs, 2-A average) conditions were used in the beam-excitation experiments. Mode spectra were measured and identified using low-power techniques employed after the high-power beam measurements. Mode frequency calculations for the complete three-washer geometry were performed using URMEL for up to m = 7. Calculated results are compared with data determined from low-power and beam-driven excitation of the DAW structure. 5 refs., 2 figs.

31863 (LA-UR—85-1618) **Revision of and documentation for the standard version of the Poisson-Group codes.** Warren, J.L.; Boicourt, G.P.; Menzel, M.T.; Rodenz, G.W.; Vasquez, M.C. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 4p. (CONF-850504—62). NTIS, PC A02/MF A01; GPO Dep. File Number DE85012659.

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

The Los Alamos Accelerator Theory and Simulation Group (AT-6) maintains and distributes a standard version of the Poisson-Group codes (LATTICE, AUTOMESH, TEKPLOT, POISSON, PANDIRA, MIRT, FORCE, SUPERFISH, and SF01). These codes are the product of man-decades of development under the guidance of R.F. Holsinger and K. Halbach. The main applications are in the design of electromagnets (POISSON and PANDIRA) and rf cavities (SUPERFISH). Other applications include electrostatics heat transport, and finding mathematical surfaces of minimum area. With special financial support from DOE-HEP, we have revised and corrected the standard version and are writing a comprehensive manual containing many examples and a summary of the theory behind the codes. This paper will illustrate some of the capabilities of the codes and will summarize the manual. The revised codes are available upon request. 3 figs., 2 tabs.

31864 (LA-UR—85-1619) **High-power rf controls for the NBS-Los Alamos racetrack microtron.** Young, L.M.; Biddle, R.S. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 4p. (CONF-850504—61). NTIS, PC A02/MF A01; GPO Dep. File Number DE85012658.

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

The high-power rf system for the National Bureau of Standards (NBS)-Los Alamos racetrack microtron (RTM) uses waveguide power splitters and waveguide phase shifters to distribute rf power from a single 500-kW cw klystron to four side-coupled accelerating structures. The amplitude and phase of each structure is controlled by a feedback system that uses the waveguide variable power splitters, waveguide phase shifters, and klystron drive as the active control elements. A block diagram of this system is shown, as is a subset of the complete system on which the measurements reported in this paper were performed. The feedback controls on the capture section use low-level rf amplitude and phase controls on the rf drive to the klystron. These controls are very fast with an open loop gain bandwidth of approximately 40 kHz. The feedback loop is identical to the feedback loop used in the chopper/buncher system described in another paper at this conference. 4 refs., 8 figs.

31865 (NAC-AR—84-01, pp 254-259) **General: Buildings.** 1984. NTIS (US Sales Only), PC A14/MF A01. File Number DE85780939.

Contains photos of the site and buildings.

In Annual report June 1984. [Council for Scientific and Industrial Research, Faure (South Africa). National Accelerator Center].

A site plan is given of the buildings of the National Accelerator Centre at Faure. The buildings which house the Van de Graaff Group are also included in this. The facilities for the new cyclotron are also discussed.

31866 (NAC-AR—84-01, pp 253) **General: mainframe computing facilities.** 1984. NTIS (US Sales Only), PC A14/MF A01. File Number DE85780939.

Short note.

In Annual report June 1984. [Council for Scientific and Industrial Research, Faure (South Africa). National Accelerator Center].

31867 (SAND—84-2395C) **Compact, low jitter, triggered spark gap.** Tucker, W.K.; Jones, E.E.; Franklin, T.L.; Bennett, L.F.; Weber, G. (Sandia National Labs., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 4p. (CONF-850616—18). NTIS, PC A02/MF A01; GPO Dep. File Number DE85012812.

From 5. IEEE pulsed power conference; Washington, DC, USA (10 Jun 1985).

High energy particle accelerators using compact, high gradient cavities will require small, highly reliable, triggered spark gaps. This paper will discuss the design and development of V/N triggered spark gaps operating from 520 kV to 1280 kV. Spark gap jitter of <3 ns has been obtained with trigger voltages of 60 kV. Capacitively balancing the trigger blade electrode, coupled with a trigger voltage rise time of 10 ns, produces three or more arcs across the main electrode gaps. A 2.3 Ω injector using 12 parallel spark gaps operating at 1280 kV has been successfully tested. The total number of shots on this injector exceeds 700 without having to refurbish the gaps. A 0.44 Ω accelerating cavity with 24 parallel spark gaps and operating at 520 kV charge voltage has also been tested.

31868 (SAND—84-2412C) **Four stage HELIA experiment.** Ramirez, J.J.; Hasti, D.E.; Corley, J.P.; Poukey, J.W.; Prestwich, K.R.; Spence, P.W.; Smith, I.D.; Schlitt, L.G.; Nishimoto, H.N.; Nielsen, K.E. (Sandia National Labs., Albuquerque, NM (USA); Pulse Sciences, Inc., San Leandro, CA (USA)). 1985. Contract AC04-76DP00789. 15p. (CONF-850616—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85012026.

From 5. IEEE pulsed power conference; Washington, DC, USA (10 Jun 1985).

A four stage, 4 MV, 250 kA, 30 ns accelerator to demonstrate the High Energy Linear Induction Accelerator (HELIA) concept is described. HELIA uses modular, water dielectric, pulse forming lines to drive inductively isolated cavities. A cathode stalk extends the length of the accelerator, adds the voltages from the cavities, and delivers the power to a high voltage anode-cathode gap. The cathode stalk constitutes the inner electrode of a coaxial magnetically insulated transmission line (MITL). The outer electrode of the MITL is not continuous but is interrupted at regular intervals by the cavity feeds. The single cavity experiment demonstrated the performance of individual cavities and pulse forming elements. The four cavity experiment demonstrated the key physics issues of the HELIA concept. The design and performance of the pulsed power driver, induction cavities, and measurements of the power delivered by the MITL to an electron beam load are presented.

31869 (SAND—84-2457C) **Kinetic loss experiments on Mite.** Stinnett, R.W.; Woodall, H.N. (Sandia National Labs., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 15p. (CONF-850616—7). NTIS, PC A02/MF A01; GPO Dep. File Number DE85012826.

From 5. IEEE pulsed power conference; Washington, DC, USA (10 Jun 1985).

We have conducted experiments on Sandia National Laboratories' Mite accelerator (2 MV, 4.8 ohms) to study the effect of geometric transitions on power flow in a magnetically insulated power feed. The effect of both changing gaps (electric convolutes) and changing line widths (magnetic convolutes) was studied. These geometric transitions caused electron losses which depended on both the abruptness of the transition and the downstream load impedance. These losses, due to perturbation of the orbits of the magnetically insulated electron flow in the anode-cathode gap, are called kinetic losses. Temporally and spatially resolved measurements of these losses were made using Faraday cups and filtered, 4-chlorostyrene, radiochromic dosimeters. The effect of an anode plasma on magnetically insulated electron flow was also studied. The kinetic losses measured in these experiments can be significant in some situations.

31870 (SAND—85-0035C) **IFA-2 collective ion accelerator experiments.** Olson, C.L.; Frost, C.A.; Patterson, E.L.; Anthes, J.P.; Poukey, J.W. (Sandia National Labs., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 16p. (CONF-850504—44). NTIS, PC A02/MF A01; GPO Dep. File Number DE85012358.

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

Ion acceleration has now been demonstrated with the IFA-2 collective ion accelerator system. The IFA-2 system is described, photoionization experiments are summarized, and ion results are presented. Using a 1 MeV electron beam and a 30 cm acceleration length, IFA-2 has produced 5 MeV H^+, 10 MeV D^+, and 20 MeV He^{++}. This means that accelerating fields of 33 MV/m over 30 cm have been achieved with a controlled collective accelerator for the first time. 4 refs., 4 figs.

31871 (SAND—85-1133C) **RADLAC technology review.** Miller, R.B. (Sandia National Labs., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 10p. (CONF-850504—32). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85011995.

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

In this paper we review the technology development associated with the RADLAC program. A basic description of the pulsed transmission line approach for constructing high power electron linacs is given, and two examples, RADLAC I and RIIM, are described in some detail. Important problems associated with the design of the high current beam transport line are also discussed. Finally, we describe a recirculating linac concept based on the use of closed accelerating cavities and ionization channel beam transport. 26 refs., 11 figs.

31872 (SLAC-PUB—3617) **Superconductors for pulsed rf accelerators.** Campisi, I.E.; Farkas, Z.D. (Stanford Linear Accelerator Center, CA (USA)). Apr 1985. Contract AC03-76SF00515. 4p. (CONF-850504—67). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85013378.

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

The choice of superconducting materials for accelerator rf cavities has been determined in the past only in part by basic properties of the superconductors, such as the critical field, and to a larger extent by criteria which include fabrication processes, surface conditions, heat transfer capabilities and so on. For cw operated cavities the trend has been toward choosing materials with higher critical temperatures and lower surface resistance, from Lead to Niobium, from Niobium to Nb_3Sn. This trend has been dictated by the specific needs of storage ring cw system and by the relatively low fields which could be reached without breakdown. The work performed at SLAC on superconducting cavities using microsecond long high power rf pulses has shown that in Pb, Nb, and Nb_3Sn fields close to the critical magnetic fields can be reached without magnetic breakdown.

31873 (UM-HE—84-1) **Accelerator physics issues for a superconducting super collider.** Tigner, M. (ed.). (Michigan Univ., Ann Arbor (USA)). 1984. 200p. (CONF-831264—Summ.). NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE85004602.

From Workshop on accelerator physics issues for a superconducting super collider; Ann Arbor, MI, USA (12 Dec 1983).

The Workshop took place December 12 through 17 at Ann Arbor, Michigan under the auspices of the University of Michigan. The principal focus of our attention was not on designs but on assessment of the SSC relevant accelerator physics tools, recipes and input data we now possess and to outline how these might be supplemented in order to complete optimized designs and cost estimates. Our survey covered matters germane to bunched and continuous beam pp and p anti p colliders as well as to acceleration of single beams. We assumed in our deliberations that beam energies up to 20 TeV and collider mode luminosities in excess of 10^{33} cm^{-2} sec^{-1} were important desiderata. In very general terms we found that the basic method and data needed for the accelerator physics component of an SSC design are in hand. Foreseeable improvements in design methods and data which will result from further theoretical and experimental work can substantially improve the cost effectiveness of an SSC design.

31874 (UM-HE—84-1, pp 13-17) **Lattice and intersection region optics.** Edwards, D.A.; Steffen, K. (Fermi National Accelerator Lab., Batavia, IL; Deutsches Elektronen-Synchroton DESY, Hamburg, Germany). 1984. NTIS, PC A09/MF A01. File Number DE85004602. (CONF-831264—Summ.).

From Workshop on accelerator physics issues for a superconducting super collider; Ann Arbor, MI, USA (12 Dec 1983).

The discussions of the group were divided in a relatively natural way beween two major topics. One related to the interaction regions where experiments were to be located, the other to the arcs of the ring and utility insertions. After some brief remarks about overall ring geometry, we follow this division here, though certain subjects are placed in one category or another in a rather arbitrary fashion.

31875 (UM-HE—84-1, pp 18-24) **Single particle stability.** Cornacchia, M. (Lawrence Berkeley Lab., CA). 1984. NTIS, PC A09/MF A01. File Number DE85004602. (CONF-831264—Summ.).

From Workshop on accelerator physics issues for a superconducting super collider; Ann Arbor, MI, USA (12 Dec 1983).

The discussions of the group covered the following topics: (1) magnetic imperfections in superconducting magnets; (2) theoretical models of single particle dynamics; (3) particle tracking; and (4) experimental studies relevant to the SSC project.

31876 (UM-HE—84-1, pp 28-31) **Single particle considerations.** Talman, R. (Cornell Univ., Ithaca, NY). 1984. NTIS, PC A09/MF A01. File Number DE85004602. (CONF-831264—Summ.).

From Workshop on accelerator physics issues for a superconducting super collider; Ann Arbor, MI, USA (12 Dec 1983).

Including the introductory section this report contains four sections. Section 2 contains a cursory survey of potentially limiting factors with references to useful information about them. Section 3 contains a discussion of the leading deleterious effect of persistent currents in the dipoles. The chromatic effect of these is so large that we are forced to assume that they will be bucked out by internal correction windings in every dipole. After this systematic effect is corrected for, random magnetic imperfections will remain. Section 4 contains a lattice design prescription for minimizing the sensitivity to magnetic field errors, and with it a presciption for picking the bore minimum imposed by single particle stability considerations.

31877 (UM-HE—84-1, pp 36-41) **Beam channel vacuum system.** Halama, H. (Brookhaven National Lab., Upton, NY). 1984. NTIS, PC A09/MF A01. File Number DE85004602. (CONF-831264—Summ.).

From Workshop on accelerator physics issues for a superconducting super collider; Ann Arbor, MI, USA (12 Dec 1983).

The SSC will require two entirely independent vacuum systems. One system will maintain the insulating vacuum for the superconducting magnets at pressures of $<10^{-5}$ torr where gas conduction introduces negligible heat load on the cyrogenic system. Similar systems have been successfully operated in 10^{-7} and 10^{-8} torr ranges at the Tevatron and in CBA full cell tests. No additional problems are envisioned. The second system, known as the Beam Vacuum System, will have to cope with new problems not present in previous proton colliders and its requirements will be treated in some detail in this report. They are: (a) low residual gas molecule density (pressure); (b) low Z/n parameter (low resistivity vacuum chamber with a minimum of discontinuities); and (c) removal of heat due to synchrotron radiation and due to the rf component of the circulating beam (1/2 R/sub s/I^2).

31878 (UM-HE—84-1, pp 42) **Beam cooling and antiproton production.** Collins, T. (Fermi National Accelerator Lab., Batavia, IL). 1984. NTIS, PC A09/MF A01. File Number DE85004602. (CONF-831264—Summ.).

From Workshop on accelerator physics issues for a superconducting super collider; Ann Arbor, MI, USA (12 Dec 1983).

This section of the Workshop was organized as a preliminary to the anti p p Workshop at the University of Chicago, February 13, 1984. The report is a preliminary report and the reader is urged to consult the Proceedings of the anti p p Workshop. Our deliberations were confined to a simple, single question: can one generate an anti p beam with sufficient intensity to make anti p p a possible alternate to a pp collider. This question is sharpened by the following: consider six interaction regions, each with $L = 10^{32}$, then anti p are consumed by collisions at a rate of 4.3×10^{11}/hour. If we discard the beam when the anti p intensity drops to one-half, then a production rate of 8.6×10^{11}/hour is necessary. The answer is: one can confidently state that these rates are not only achievable, but very practical using present technology.

31879 (UM-HE—84-1, pp 43) **SPS collider.** Gareyte, J. (CERN, Geneva, Switzerland). 1984. NTIS, PC A09/MF A01. File Number DE85004602. (CONF-831264—Summ.).

From Workshop on accelerator physics issues for a superconducting super collider; Ann Arbor, MI, USA (12 Dec 1983).

The main characteristics of the SPS collider are given.

31880 (UM-HE—84-1, pp 45-49) **Tevatron as an SSC prototype; experience versus predictions.** Johnson, R.P. (Fermilab, Batavia, IL). 1984. NTIS, PC A09/MF A01. File Number DE85004602. (CONF-831264—Summ.).

From Workshop on accelerator physics issues for a superconducting super collider; Ann Arbor, MI, USA (12 Dec 1983).

Early machine experiments on the Tevatron which are relevant to the SSC are discussed. Despite the preliminary nature of the data, there have been some interesting observations which may influence the design of the SSC. In particular, comparisons of measured betatron tunes, chromaticities, and resonance line widths with those predicted from computer simulations using magnetic field measurements have been made; the predictability for low order phenomena seems acceptable. Coasting beam studies indicate long lifetime and lack of strong resonance driving terms. Low energy studies of beam behavior indicate that a dynamic range of a factor of 15 from injection to operation energy should be possible.

31881 (UM-HE—84-1, pp 86-88) **Survey and alignment requirements and techniques for the SSC.** Norem, J.H. (Argonne National Lab., IL). 1984. NTIS, PC A09/MF A01. File Number DE85004602. (CONF-831264—Summ.).

From Workshop on accelerator physics issues for a superconducting super collider; Ann Arbor, MI, USA (12 Dec 1983).

Although in normal operation the beam position in the SSC accelerator will be maintained by position correction magnets, an accurate survey and alignment system is necessary as a guide for civil engineering and initial placement of accelerator components. Because of the size of the machine, the survey system should be fast, reliable, and if possible highly automated. The tolerances for magnet position should be comparable to existing accelerators; a fraction of a mm for quadrupole position relative to the beam axis, and somewhat looser requirements for bending magnets. Over long distances considerable distortion of the circular orbit is tolerable. This paper summarizes the requirements for alignment of accelerator components and lists some techniques presently in use and some which might be useful. More detailed reviews have been made elsewhere. 17 refs.

31882 (UM-HE—84-1, pp 89-92) **Design considerations and procedures for the SSC (with appendix on terrain following).** Teng, L.C. (Fermi National Accelerator Lab., Batavia, IL). 1984. NTIS, PC A09/MF A01. File Number DE85004602. (CONF-831264—Summ.).

From Workshop on accelerator physics issues for a superconducting super collider; Ann Arbor, MI, USA (12 Dec 1983).

We outline the rationale, the logistics and procedure for choosing the more crucial parameters of the SSC. The parameter values are given only to illustrate the procedure and do not represent an optimal choice-set for an example design. 5 figs.

31883 (UM-HE—84-1, pp 155-156) **Coupling impedance of position monitor electrodes.** Shafer, R.E. (Fermi National Accelerator Lab., Batavia, IL). 1984. NTIS, PC A09/MF A01. File Number DE85004602. (CONF-831264—Summ.).

From Workshop on accelerator physics issues for a superconducting super collider; Ann Arbor, MI, USA (12 Dec 1983).

As the design energy of new machines increases and the beampipe diameter decreases, the upper limit on the longitudinal and transverse coupling impedances for beam stability requirements become lower. It appears now that for a 20 TeV ring with a b = 2.5 cm beampipe that Z_{11}/n is about 1 ohm and Z/sub T/ is about 10^8 ohm/m. (These parameters are of course machine design dependent.) The major sources of these impedances are resistive wall, bellows and step discontinuities, rf cavities, Lambertsons and kickers, and position monitor electrodes. In most cases, careful design and selection of materials can minimize the impedance contribution of individual components. In the case of beam position pickup electrodes, however, the basic design objective is to couple energy out of the beam. Since the nature of this coupling is frequency dependent, the real part of the coupling impedance (i.e., signal power) and the imaginary component (longitudinal stability impedance) are related by causality (the Kramer-Kroenig relation). The purpose of this note is to discuss the basic design of the pickup electrodes, the impedance calculations, and estimates for the Superconducting Super Collider.

31884 (UM-HE—84-1, pp 157-160) **Limitations on beam intensity.** Wenzel, W.A.; Finley, D.; Harrison, M.; Murphy, C.T.; Turkot, F.; Martin, R. (Lawrence Berkeley Lab., CA; Fermi National Accelerator Lab., Batavia, IL; Argonne National Lab., IL). 1984. NTIS, PC A09/MF A01. File Number DE85004602. (CONF-831264—Summ.).

From Workshop on accelerator physics issues for a superconducting super collider; Ann Arbor, MI, USA (12 Dec 1983).

Research needs may require several gigajoules of stored beam energy in the SSC. There is no fundamental limitation to operation in this range. A variety of mutually supportive and redundant design features can assure safe operation and reliability of the fast abort and beam dump systems. The stability of operation can depend on details of the superconducting magnet design. The most severe research limitations are anticipated for the conventional fixed target program.

31885 (UM-HE—84-1, pp 172-175) **Feasibility study of stochastic cooling of bunches in the SPS.** Boussard, D.; Chattopadhyay, S.; Dome, G.; Linnecar, T. (CERN, Geneva, Switzerland). 1984. NTIS, PC A09/MF A01. File Number DE85004602. (CONF-831264—Summ.).

From Workshop on accelerator physics issues for a superconducting super collider; Ann Arbor, MI, USA (12 Dec 1983).

The average luminosity of the SPS collider could be improved if the slow blow-up of transverse emittances due to beam-beam and intra beam scattering effects were to be reduced by a transverse cooling system. We shall examine the parameters of such a system and propose a technological approach which seems better suited to the case of a few bunches circulating in a large machine.

31886 (UM-HE—84-1, pp 184) **Photoelectron yields from synchrotron radiation in the SSC.** Hseuh, H.C. (Brookhaven National Lab., Upton, NY). 1984. NTIS, PC A09/MF A01. File Number DE85004602. (CONF-831264—Summ.).

From Workshop on accelerator physics issues for a superconducting super collider; Ann Arbor, MI, USA (12 Dec 1983).

In the SSC, the synchrotron radiation generated by the circulating beam will liberate photoelectrons from the chamber walls, which in turn will desorb the surface molecules. The photoelectron yields depend on the photon energy and the chamber material. Here we calculate the photon energy distribution of the synchrotron radiation for 20 TeV, SSC with 3 Tesla and 8 Tesla magnets. The total number of photoelectrons produced is calculated using the known photoelectron yield of Al and the photon energy distribution.

31887 **Operation of a plasma focus device as a compact electron accelerator.** Smith, J.R.; Luo, C.M.; Rhee, M.J.; Schneider, R.F. (Naval Surface Weapons Center, White Oak, Silver Spring, Maryland 20910). *Physics of Fluids;* **28**: No. 7, 2305-2307(Jul 1985).

The electron beam produced by a compact plasma focus device has been investigated. The Mather geometry plasma focus electrodes were modified to permit extraction of accelerated electrons. Performance of the plasma focus as an electron accelerator using different gas species and pressures is investigated. Also, results from measurements of the beam parameters are given.

31888 **(LA-tr—85-25) Investigation of the ion source of a neutron tube.** Voitsik, L.R.; Erozolimskii, B.G. Translated from *Trudy, Vsesoyuznyi Nauchno-Issledovatel'skii Institut Yadernoi Geofiziki i Geokhimii ;* No. 1, 144-147(1968). Contract W-7405-ENG-36. 10p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85013266. DE85013266

In connection with the necessity of reducing the dimensions of the impulse neutron tube experiments were done to explain the possibilities of reducing the dimensions of the ion source while maintaining a sufficient rate of the ion flow. 1 ref., 4 figs.

4302 Beam Dynamics, Field Calculations, And Ion Optics

REFER ALSO TO CITATION(S) 31881, 31885, 31981, 32001, 32002, 32004, 32991

31889 **(AD-A—151392/8/XAB) Beam trapping in high-current cyclic accelerators with strong-focusing fields. Memorandum report, January-December 1984.** Sprangle, P.; Kapetanakos, C.A. (Naval Research Lab., Washington, DC (USA)). 6 Mar 1985. 23p. (NRL-MR—5458). NTIS, PC A02/MF A01.

In cyclic induction accelerators, the energy of the particles increases slowly in synchronism with the vertical (betatron) magnetic field. As a consequence of the slow acceleration, the charged particles must be confined by the weak-focusing magnetic field over long periods of time, and thus field errors, instabilities, and radiation losses can impose limitations on the acceleration process. These limitations can be substantially relaxed if the acceleration were to occur rapidly, say over a few microseconds. An appropriate name for such an accelerator is REBA-TRON (Rapid Electron Beam Accelerator). This paper considers a possible mechanism which could trap a high current electron beam in the strong focusing magnetic fields of the rebatron. We investigate a possible mechanism for trapping an intense relativistic electron beam confined by strong focusing fields. In our model the electron beam is assumed to be injected into torsatron fields off axis, near the chamber walls. The finite resistivity of the walls results in a drag force on the beam centroid which may cause the beam to spiral inward towards the axis of the chamber. We have analyzed this mechanism and obtained decay rates for the inward spiraling beam motion.

31890 **(AD-A—151420/7/XAB) Modified betatron accelerator studies. Final report.** Hughes, T.P.; Godfrey, B.B. (Mission Research Corp., Albuquerque, NM (USA)). Dec 1984. 117p. NTIS, PC A06/MF A01.

This final report describes work carried out on the equilibrium and stability properties of circular accelerators. A rigid-disk beam model in which the fields are treated exactly is used to study linear instabilities. This approach has uncovered an important inductive effect which at high toroidal mode numbers leads to either stability or to a hybrid instability. A corresponding effect has been found in electron-layer geometry. The new theory also shows that moving the equilibrium position toward the inner wall can stabilize low mode numbers. With the aid of IVORY code simulation results it is shown that the transverse motion of beam partilces is a key factor in determining beam stability. The upper bound on particle circulation frequency spread is shown to be a function only of the beam major and minor radii. This leads to upper bounds on stable currents in the modified betatron. Numerical results on stability in the stellatron and reversing-solenoidal-lens betatrons are presented. In addition, the sensitivity of equilibrium particle orbits in the stellatron to initial conditions is calculated.

31891 **(ANL-HEP-CP—85-27) Comparison between theoretical predictions and tracking.** Ruggiero, A.G. (Argonne National Lab., IL (USA)). 1985. Contract W-31-109-ENG-38. 38p. (CONF-8503105—3). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85012104.

From Orbital dynamics and applications to accelerators workshop; Berkeley, CA, USA (7 Mar 1985).

The beam-beam interaction in a proton-antiproton collider has been an outstanding issue for a long time. Several theoretical predictions have been made in the past which range from the appearance of single beam-beam driven resonances to the onset of stochasticity and Arnold diffusion and the presence of chaotic trajectories. All these effects would cause a limit on the maximum strength of the beam-beam interaction, the so called beam-beam tune-shift, and speculative values have been offered ranging from as low as 0.0005 to as large as a fraction of unit. The lower limit could be caused in a more complicated situation where the external focussing forces which keep the two beams in the same storage ring are also modulated in time. These theoretical predictions have been compared with extensive computer tracking where the motion of the particles is followed turn after turn over very long periods of time. Though it is indeed possible to observe the formation of several resonances, nevertheless the onset of connected stochasticity seems to occur at too large beam-beam tune-shift to be of any practical relevance. Moreover no Arnold diffusion has been observed to have any practical significance. Chaotic trajectories have been found to embed the phase space in disconnected regions of appreciable extension. They increase in numbers considerably when time modulation of external focussing forces is added. 15 refs., 18 figs.

31892 **(CERN-EP—82-214) Phase-space cooling of ion beams.** Moehl, D.; Kilian, K. (European Organization for Nuclear Research, Geneva (Switzerland)). 23 Dec 1982. 25p. (CONF-8210108—4). NTIS (US Sales Only), PC A02/MF A01. File Number DE85900498.

From Detectors in heavy ion physics workshop in memory of Hans Geiger; Berlin, F.R. Germany (6 Oct 1982).

Cooling of proton and antiproton beams has recently led to spectacular results. Amongst these are the increase of the lifetime of stored beams by a factor of 50 due to the compensation of blow-up by multiple scattering on the residual gas; the non-destructive observation of as few as 50 circulating particles (corresponding to a beam current of 3×10^{-11} A), by reducing their frequency spread to less than 10^{-5}; the accumulation of 2×10^{11} antiprotons from batches of about 3×10^{6}; the preparation of sharply collimated beams with a final beam size of less than a millimetre and a momentum spread of 10^{-4} at intensities of 10^{8} to 10^{9} circulating protons. At CERN, these new techniques have made an ambitious programme of antiproton physics possible, covering a large range of energies from almost 0 to 600 GeV/c in the centre of mass and with beams of very high quality. In the light of these achievements and prospects it is natural to consider the application of similar techniques to other rare particles like heavy-ion and/or polarized-particle beams. The use of electron cooling in this context was in fact suggested already some time ago by the Novosibirsk group. In the present paper we try to work out in some detail the features of both stochastic and electron cooling of heavy-ion beams. The problems considered are cooling times, beam lifetime, particle loss due to electron capture, equilibrium states, and possible experimental techniques and applications. 28 refs., 7 figs., 4 tabs.

31893 **(CERN-EP—85-27) Realistic calculations concerning electron cooling in storage rings.** Wolf, A. (European Organization for Nuclear Research, Geneva (Switzerland)). 4 Mar 1985. 20p. (CONF-8409171—3). NTIS (US Sales Only), PC A02/MF A01. File Number DE85900488.

From Workshop on electron cooling; Karlsruhe, F.R. Germany (22 Sep 1984).

This report gives a critical survey of methods available for calculating electron cooling rates in a storage ring. The real conditions of electron cooling are compared with the assumptions commonly made in cooling force calcultions. The relevance of cooling rates and their calculation from cooling forces is discussed. Results of a numerical simulation of electron cooling are presented which include an accurate microscopic description of the cooling force and take into account technical imperfections of the electron cooling device.

31894 **(FNAL/C—85/63) Deprit's algorithm, Green's functions, and multipole perturbation theory.** Michelotti, L. (Fermi National Accelerator Lab., Batavia, IL (USA)). Apr 1985. Contract AC02-76CH03000. 5p. (CONF-8503105—4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85012297.

From Orbital dynamics and applications to accelerators workshop; Berkeley, CA, USA (7 Mar 1985).

Within the context of accelerator multipole theory, we describe a method for solving Deprit's equations using a periodic Green's function. This procedure, implemented in a MACSYMA program, has been applied to a Hamiltonian with a normal sextupole term, and the averaged or renormalized Hamiltonian has been calculated to fourth order in sextupole strength. Anticommutativity of the bracket algebra explains the observed slow growth in the number of induced resonances with order. 3 refs., 1 tab.

31895 **(JINR—1-83-910) Neutral particle 4N channel of Serpukhov accelerator.** Aleev, A.N.; Aref'ev, V.A.; Balandin, V.P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1983. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85701062.

The neutral particle 4N channel constructed at Serpukhov accelerator is described. The channel is designed for high energy neutron beam production. The neutron beam has the following characteristics: average energy of neutrons is (40+-5) GeV, intensity - approximately 10^6 neutrons/cycle over 10^{11} protons striking onto internal target, impurity of charge particles -about 2%, beam dimensions - 50 mm horizontally, 60 mm vertically (in the region of BIS-2 spectrometer). Zn-beam experiments on the search for charmed particles and narrow baryon resonances in hadron-hadron interactions have been successfully performed during several years by means of BIS-1, BIS-2 spectrometers.

31896 **(JINR—9-84-129) Calculation of some characteristics of the beam dynamics in the central region of the U-400 cyclotron.** Korman', Z. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1984. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85701063.

The ion motion in the central region of the four-meter isochronous cyclotron for the second harmonic mode acceleration is studied. Measured data of the real magnetic field of the cyclotron and calculated three-dimensional electric field of the dees have been used while calculating. The disadvantageous effects of the transverse electric field are shown, which effect particle motion in the beginning of the second turn. The possibility of improvement of the beam quality by screening this region from the electric filed was investigated. The modification leads to the better centering of orbits and increase of vertical acceptance of the geometry approximately by 2.5 times.

31897 **(JINR—R-11-83-893) Two-dimensional magnetic field numerical simulation of 3 T superconducting dipole with iron yoke.** Borisovskaya, Z.V.; Zhidkov, E.P.; Kuts, I.V.; Polyakova, R.V.; Shelaev, I.A.; Yudin, I.P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy; Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1983. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85701061.

A numerical investigation of a possibility to get an acceptable technological configuration of superconducting (SC) dipole that provides high-homogeneous 3 T field is carried out. The dependence of the field nonlinearity with a value of B induction is received. Two types of SC dipoles with rectangular aperture are compared. Two methods of two-dimensional magnetic field simulation in the magnets with rectangUlar aperture are compared. These calculations have been performed using POISSON and MIC2M programs. The results indicate that this SC dipole configuration provides the 3 T value of high-homogeneous field in the magnet aperture, while the magnet induction inside the yoke does not exceed 2.1 T.

31898 **(LA-UR—85-1526) Rf program for LAMPF II.** Colton, E.P. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 4p. (CONF-850504—120). NTIS, PC A02/MF A01; GPO Dep. File Number DE85012693.

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

The rf program is chosen to maintain a bucket/bunch area ratio of at least two during rf capture, acceleration, injection, and extraction. At 0.797 GeV the beam bunch area is 0.0635 eVs. We show the behavior of the rms bunch length and dp/p during acceleration. The rf system must provide a voltage of 1.59 MV/turn for the booster and 5.0 MV/turn for the main ring. 7 refs., 5 figs.

31899 **(LA-UR—85-1528) Measurement and resulting first and second order approximations for a 9 degree bending magnet in LAMPF's 750-keV transport.** Hurd, J.W. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 4p. (CONF-850504—118). NTIS, PC A02/MF A01; GPO Dep. File Number DE85012691.

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

The three Cartesian components of magnetic field are measured for a 9 degree bending magnet. Measurement errors are corrected and the data is fit to a polynomial which satisfies Maxwell's equations. Particle paths through the magnet are calculated by numerical integration and the corresponding first and second order particle transformation matrices are generated. A parameterization for the first order transformation matrix is developed and the resulting approximations for predicting particle motion in the magnet are compared to the results of the numerical integration.

31900 **(LA-UR—85-1610) Cw operation of the FMIT RFQ accelerator.** Cornelius, W.D. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 7p. (CONF-850504—46). NTIS, PC A02/MF A01; GPO Dep. File Number DE85012667.

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

Recently, we have achieved reliable cw operation of the Fusion Materials Irradiation Test (FMIT) radio-frequency quadrupole (RFQ) accelerator. In addition to the operational experiences in achieving this status, some of the modifications of the vacuum system, cooling system, and rf structure are discussed. Preliminary beam-characterization results are presented. 10 refs., 8 figs.

31901 **(LA-UR—85-1615) Noninterceptive techniques for the measurement of longitudinal parameters for intense H^- beams.** Cottingame, W.B.; Boicourt, G.P.; Cortez, J.H.; Higgins, W.W.; Sander, O.R.; Sandoval, D.P. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 4p. (CONF-850504—53). NTIS, PC A02/MF A01; GPO Dep. File Number DE85012662.

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

With increasing brightness, beam diagnostic techniques requiring interception of the beam become impractical. For H^- particle beams, solutions for this problem based on the phenomenon of photodissociation are currently under investigation at the Los Alamos National Laboratory accelerator test stand (ATS). A laser can be used to selectively neutralize portions of the beam that can be characterized after the charged particles have been swept away. We have used this technique for the measurement of current density versus longitudinal phase and the longitudinal phase-space distribution at the output of the ATS radio frequency quadrupole (RFQ). The results of our measurement are compared with the predictions of the particle-dynamics code, PARMTEQ. 2 refs., 6 figs.

31902 **(LA-UR—85-1622) Relation between field energy and RMS emittance in intense particle beams.** Wangler, T.P.; Crandall, K.R.; Mills, R.S.; Reiser, M. (Los Alamos National Lab., NM (USA); Maryland Univ., College Park (USA)). 1985. Contract W-7405-ENG-36. 6p. (CONF-850504—58). NTIS, PC A02/MF A01; GPO Dep. File Number DE85012655.

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

An equation is presented for continuous beams with azimuthal symmetry and continuous linear focusing, which expresses a relationship between the rate of change for squared rms emittance and the rate of change for a quantity we call the nonlinear field energy. The nonlinear field energy depends on the shape of the charge distribution and corresponds to the residual field energy possessed by beams with nonuniform charge distributions. The equation can be integrated for the case of an rms matched beam to yield a formula for space-charge-induced emittance growth that we have tested numerically for a variety of initial distributions. The results provide a framework for discussing the scaling of rms emittance growth and an explanation for the well-established lower limit on output emittance. 15 refs., 4 figs.

31903 **(LA-UR—85-1654) Considerations on collective ion acceleration as an intense ion injector.** Faehl, R.J.; Peter, W.K. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 11p. (CONF-850504—90). NTIS, PC A02/MF A01; GPO Dep. File Number DE85012706.

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

A virtual cathode collective acceleration configuration is examined for use as a pulsed, intense ion injector. Numerical calculations of the collective acceleration have shown peak ion energies of several times that of the electron beam energy. This is consistent with a variety of experiments. The late time behavior is to accelerate ions to lower energies but at a higher current. This is characteristic of a reflex ion triode, which produces an ion beam largely charged but not current neutralized. Dynamic neutralization must be achieved if accelerator applications requiring transport and focusing are to be realized. Representative applications have been simulated and are discussed. 10 refs., 6 figs.

31904 **(LA-UR—85-1682) Transverse emittance of a 2.0-MeV RFQ beam with high brightness.** Sander, O.R.; Boicourt, G.P.; Cottingame, W.B. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 4p. (CONF-850504—86). NTIS, PC A02/MF A01; GPO Dep. File Number DE85012718.

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

One major purpose of the accelerator test stand (ATS) is to see if particle simulation codes can correctly predict the output beam parameters of our radio-frequency quadrupole (RFQ) linac. By injecting a very bright 100-keV beam (100 mA, 0.02 π x cm x mrad) and comparing the measured output beam parameters with those predicted (using PARMTEQ), we can investigate PARMTEQ's performance in a high space-charge regime. PARMTEQ has successfully simulated the RFQ beam transmission and energy distribution; it is more difficult to simulate output transverse emittance. Transverse emittance is also difficult to measure because of the high-power-density beam. Special modification of our interceptive slit and collector equipment was required. This paper will compare measured transverse emittances with those predicted. 3 refs., 7 figs.

31905 **(N—85-16728) (20)Ne interaction in extended matter.** Wilson, J.W.; Townsend, L.W. (National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center). Dec 1984. 16p. (NASA-TM—86312). NTIS, PC A02/MF A01.

Although heavy ion transport theory is developed to a relatively advanced stage, the present limitation in biomedical and electronic applications is the uncertainty in nuclear fragmentation parameters. The present status on Ne-20 beams is discussed and useful formulae are presented for future use in analysis of beam transport experiments.

31906 **(NIIEFA-P-B—0587) Betatron oscillation frequency shift in large cyclic accelerators.** Belov, V.P. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR)). 1983. 20p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85701064.

The effect of magnetic field nonlinearities on the betatron oscillation frequency shift in large cyclic accelerators taking into account the closed orbit distortions is considered. Rather compact formulae connecting the frequency shift with the arbitrary order magnetic field nonlinearity amplitude for a beam with arbitrary emittance and dispersion are obtained. Testing calculations of magnetic field nonlinearity tolerances in the first stage of the accelerating storage complex are carried out.

31907 **(SAND—84-2398C) Vacuum interface flashover with bipolar electric fields.** Tucker, W.K.; Anderson, R.A.; Hasti, D.E.; Jones, E.E.; Bennett, L.F. (Sandia National Labs., Albuquerque, NM (USA)). May 1985. Contract AC04-76DP00789. 13p. (CONF-850616—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE85012027.

From 5. IEEE pulsed power conference; Washington, DC, USA (10 Jun 1985).

High energy, compact, particle accelerators require accelerating cavities that have large gradients and operate with high efficiency. The bipolar electric fields required in these efficient accelerating cavities place severe requirements on the vacuum interface. Experimentally, we have found that the bipolar flashover field varies as t/sup -1/2/ for times out to 300 ns and then remains essentially constant at 33 kV/cm for longer duration waveforms, whereas materials subjected to unipolar electric fields follow a t/sup -1/6/ relationship. Furthermore, specific accelerating cavities offer enhancements that may be employed to achieve highly uniform electric fields across the vacuum interface. Using these results and the results of a previously developed theory of unipolar flashover, a new interface has been designed and 50 kV/cm bipolar flashover field achieved for a waveform train that lasted 1 μs. This paper will discuss the design of this vacuum interface and the evaluation of various materials that led to achieving bipolar flashover fields 50% greater than we had previously obtained for long duration waveforms. 10 refs., 6 figs.

31908 **(SAND—84-2421C) Measurement and interpretation of electron angle at MABE beam stop.** Sanford, T.W.L.; Coleman, P.D.; Poukey, J.W. (Sandia National Labs., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 4p. (CONF-850504—37). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85011918.

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

This analysis shows that radiation measurements combined with a sophisticated simulation provides a simple but powerful tool for estimating beam temperature in intense pulsed annular electron-beam accelerators. Specifically, the mean angle of incidence of a 60 kA, 7 MeV annular electron-beam at the beam stop of the MABE accelerator and the transverse beam temperature are determined. The angle is extracted by comparing dose profiles measured downstream of the stop with that expected from a simulation of the electron/photon transport in the stop. By calculating and removing the effect on the trajectories due to the change in electric field near the stop, the beam temperature is determined. Such measurements help give insight to beam generation and propagation within the accelerator. 9 refs., 6 figs., 1 tab.

31909 **(SLAC-PUB—3621) Rf beam deflection measurements and corrections in the SLC linac.** Seeman, J.T.; Ross, M.C.; Sheppard, J.C.; Stiening, R.F. (Stanford Linear Accelerator Center, CA (USA)). Apr 1985. Contract AC03-76SF00515. 3p. (CONF-850504—111). NTIS, PC A02/MF A01; GPO Dep. File Number DE85013061.

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

The requirements of rf acceleration in the SLC linac to produce high energy beams are complicated by the presence of small transverse rf beam deflections which arise from several sources. These rf deflections place stringent tolerances on the phase and amplitude stability of the klystrons. They also force the use of special magnetic bumps to correct the trajectories of oppositely charged beams that will pass down the linac. If left unabated, rf deflections can limit the performance of the SLC. There are several methods to reduce the deflections. Many measurements of rf deflections have been made in the low energy part of the linac where the beams are most sensitive. 4 refs., 8 figs., 2 tabs.

31910 **(SLAC-PUB—3640) High resolution beam profile monitors in the SLC.** Ross, M.C.; Seeman, J.T.; Jobe, R.K.; Sheppard, J.C.; Stiening, R.F. (Stanford Linear Accelerator Center, CA (USA)). Apr 1985. Contract AC03-76SF00515. 3p. (CONF-850504—66). NTIS, PC A02/MF A01; GPO Dep. File Number DE85013375.

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

In the SLC linac, low emittance beams with typical transverse dimensions less than 0.2 mm must be accelerated without effective emittance growth. In order to monitor this we have installed a high resolution beam profile monitor system which consists of an aluminum target covered with a fine-grained phosphor, a magnifying optical system, a television camera and video signal recording electronics. The image formed when the beam strikes the phosphor screen is viewed on a CRT monitor at the console and selected horizontal and vertical slices of the beam spot intensity are recorded. A 20 MHz transient waveform recorder is used to sample and digitize the raw video signal along the selected slice. The beam width is determined by fitting the background subtracted data to a Gaussian. Beam spots less than 6 x 3 mm can be viewed. Beam spot sizes σ/sub x,y/ < 80 μm have been measured. 9 refs., 4 figs.

31911 **(SLAC-PUB—3673) Observations of accelerated high current low emittance beams in the SLC Linac.** Seeman, J.T.; Ross, M.C.; Sheppard, J.C.; Stiening, R.F. (Stanford Linear Accelerator Center, CA (USA)). May 1985. Contract AC03-76SF00515. 4p. (CONF-850504—85). NTIS, PC A02/MF A01; GPO Dep. File Number DE85013073.

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

The Linac of the SLAC Linear Collider (SLC) is required to accelerate several intense single electron and positron bunches to high energy while not enlarging their small transverse emittances. The improvements needed by the SLAC Linac to meet these goals have very stringent design criteria. As partial systems have become available, beam tests have been performed to confirm the designs. The results of those beam tests are discussed. Future plans of the improvement program are described. 13 refs., 9 figs.

31912 **(UCRL—15660) High brightness cathode experiments on the experimental test accelerator (ETA). Final report.** Schlitt, L.; Proulx, G. (Pulse Sciences, Inc., San Leandro, CA (USA)). 1984. Contract W-7405-ENG-48. 69p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85012958.

The experiments performed on the ETA during the months of September through October of 1984 were intended to accomplish two objectives; to discover or develop a source capable of producing an electron beam whose brightness is substantially higher than that of previous sources, and to determine, if possible, the mechanisms which limit the source brightness so that further enhancements might be obtained. The results of the experiments met these objectives to a limited degree. A cathode material (velvet) and a diode geometry were identified which resulted in more than a factor of two improvements in brightness over that obtained with previous flashboard cathodes. Experiments were performed which have yielded information about mechanisms which may limit beam brightness, and have suggested approaches for further work to improve brightness. However, the desired brightness of 10^5 A/(cm^2-rad^2) was not achieved in these experiments. This report contains a discussion of the cathodes used, the diode geometries employed, the diagnostics, the typical characteristics of a single beam experiment, and the characteristics of the collimator used to measure the brightness. The entire ensemble of brightness data is presented and broken down into classes of experiments. In addition, the results of an EBQ calculation of one diode geometry are discussed, and differences between the results of similar experiments on ETA and ATA are noted. Finally, conclusions and recommendations are presented.

31913 **(UCRL—91936) Technology of magnetically driven accelerators.** Birx, D.L.; Hawkins, S.A.; Poor, S.E.; Reginato, L.L.; Rogers, D. Jr.; Smith, M.W. (Lawrence Livermore National Lab., CA (USA)). 26 Mar 1985. Contract W-7405-ENG-48. 21p. (CONF-850504—33). NTIS, PC A02/MF A01; GPO Dep. File Number DE85011857.

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

The marriage of Induction Linac technology with Nonlinear Magnetic Modulators has produced some unique capabilities. It appears possible to produce electron beams with average currents measured in amperes, at gradients exceeding 1 MeV/meter, and with power efficiencies approaching 50%. A 2 MeV, 5 kA electron accelerator has been constructed at the Lawrence Livermore National Laboratory (LLNL) to demonstrate these concepts and to provide a test facility for high brightness sources. The pulse drive for the accelerator is based on state-of-the-art magnetic pulse compressors with very high peak power capability, repetition rates exceeding a kilohertz and excellent reliability. 8 figs., 1 tab.

31914 **(UM-HE—84-1, pp 5-12) Primary parametric relationships.** 1984. NTIS, PC A09/MF A01. File Number DE85004602. (CONF-831264—Summ.).

From Workshop on accelerator physics issues for a superconducting super collider; Ann Arbor, MI, USA (12 Dec 1983).

High luminosity will be necessary for the study of many of the new phenomena expected in the SSC energy region. Particle detectors, however, are limited in the number of simultaneous interactions which they can handle, and thus need a good duty cycle with collisions spread out in time to the greatest extent possible. To avoid the larger number of stored protons now thought to be required for continuous beams, we have considered bunched beams of protons crossing at a small angle. Plots are given of the dependence on bunch separation of the emittance, number of protons, etc., needed for 10^{33}cm^{-2}sec^{-1}. In order to minimize the number of stored protons ($\sim 10^{14}$/ring), an emittance roughly ten times smaller than that presently achieved at high energies is required for a bunch separation of 6 meters (20 nsec).

31915 **(UM-HE—84-1, pp 25-27) Single beam collective effects in the SSC.** Siemann, R.H. (Cornell Univ., Ithaca, NY). 1984. NTIS, PC A09/MF A01. File Number DE85004602. (CONF-831264—Summ.).

From Workshop on accelerator physics issues for a superconducting super collider; Ann Arbor, MI, USA (12 Dec 1983).

Crucial issues for this Workshop are evaluations of our ability to calculate the important impedances ab initio and to use them to predict all instability thresholds accurately. That this is important is seen by estimates which indicate that for typical SSC parameters, we need (Z/sub parallel//n) $\leqq$ 1 ohm. Such low impedances have been achieved in electron machines purposely so designed. Impedance computations have been performed for these cavity dominated electron storage rings and have used in conjunction with numerical simulations to explain observed single beam instabilities. There is a strong interaction between theoretical and computer simulation development and measurements made in accelerators. During the discussion of the issues, measurements that are needed will be pointed out. 22 refs.

31916 **(UM-HE—84-1, pp 32-33) Magnet imperfections and collective effects.** Palmer, R. (Brookhaven Natioal Lab., Upton, NY). 1984. NTIS, PC A09/MF A01. File Number DE85004602. (CONF-831264—Summ.).

From Workshop on accelerator physics issues for a superconducting super collider; Ann Arbor, MI, USA (12 Dec 1983).

The random sextupole field variations in the magnets assumed in the above analysis were 1.7 m^{-2} for a small SSC magnet with 3.5 cm inside coil and 7 m^{-2} for a very small SSC magnet with coil inside diameter of only 1.5 cm. These values were obtained from an analysis of observed fluctuations in the CBA magnets. This analysis revealed two components in the magnet errors. The first component arises from fixed mechanical errors due to punching accuracy or machining accuracies in wedges, pole spaces, etc. Multipole effects from such errors will be relatively greater as the mean coil diameter is made smaller, and in fact would be expected to increase as the inverse cube of that radius. The other type of error arises from fractional or angular deviations such as would arise from non-uniformity in conductor thickness. Such errors will increase only as the inverse square of the mean coil radius.

31917 (UM-HE—84-1, pp 34-35) **Rf and feedback systems.** Lambertson, G. (Lawrence Berkeley Lab., CA). 1984. NTIS, PC A09/MF A01. File Number DE85004602. (CONF-831264—Summ.).

From Workshop on accelerator physics issues for a superconducting super collider; Ann Arbor, MI, USA (12 Dec 1983).

At the outset of the group's work, presentations and discussions served to introduce participants to the SSC features defining the RF system requirements and to the limited design work done up to that time. Following that, the group: (1) developed example parameters for an rf system; (2) discussed the evaluation of rf noise problems; and (3) considered the nature of feedback systems for control of both longitudinal and transverse beam excursions and instabilities. We acknowledge valuable discussions paricularly with members of the stability group.

31918 (UM-HE—84-1, pp 56-57) **Beam-beam resonance criteria for high Q/sub s/ and low crossing angles.** Peggs, S. (CERN, Geneva, Switzerland). 1984. NTIS, PC A09/MF A01. File Number DE85004602. (CONF-831264—Summ.).

From Workshop on accelerator physics issues for a superconducting super collider; Ann Arbor, MI, USA (12 Dec 1983).

Suppose that the SSC has a tune modulation of amplitude Q at a frequency Q/sub s/, for example through non-zero chromaticity and energy spread. Near a one-dimensional beam-beam resonance of order N this leads to synchrobetatron sidebands. If the sidebands overlap (the Chirikov-Courant criterion), chaos ensues, but only in this amplitude range. For given collision strengths chaos occurs if the band is above a critical amplitude a/sub c/. Lower amplitude particles are inherently more stable against beam-beam resonances.

31919 (UM-HE—84-1, pp 58) **Beam-beam resonance suppression by clustered IR's.** Peggs, S. (CERN, Geneva, Switzerland). 1984. NTIS, PC A09/MF A01. File Number DE85004602. (CONF-831264—Summ.).

From Workshop on accelerator physics issues for a superconducting super collider; Ann Arbor, MI, USA (12 Dec 1983).

If there are m collisions in the SSC, a resonant vector is associated with the i'th collision. The resonance is suppressed if the vector sum disappears.

31920 (UM-HE—84-1, pp 59) **Intra-beam scattering with vertical dispersion.** Piwinski, A. (Deutsches Elektronen-Synchrotron DESY, Hamburg, Germany). 1984. NTIS, PC A09/MF A01. File Number DE85004602. (CONF-831264—Summ.).

From Workshop on accelerator physics issues for a superconducting super collider; Ann Arbor, MI, USA (12 Dec 1983).

Without vertical dispersion the intra-beam scattering would reduce the beam height in large storage rings as the SPS Collider or the SSC. A spurious vertical dispersion, however, is inevitable. It is caused by orbit errors in quadrupoles and sextupoles, and therefore increases with increasing number of quadrupoles and sextupoles, i.e. it will be large in large storage rings. The following formulae show that even a small vertical dispersion leads to an increase of the beam height.

31921 (UM-HE—84-1, pp 60-62) **Polarized protons in the SSC.** Terwilliger, K.M.; Krisch, A.D.; Courant, E.D.; Cho, Y.; Martin, R.L.; Ruth, R.D.; Steffen, K.; Teng, L.C.; LaClare, J.L. (Univ. of Michigan, Ann Arbor; Brookhaven National Laboratory, Upton, NY; Argonne National Lab., IL; Lawrence Berkeley Lab., CA; DESY, Hamburg, Germany). 1984. NTIS, PC A09/MF A01. File Number DE85004602. (CONF-831264—Summ.).

From Workshop on accelerator physics issues for a superconducting super collider; Ann Arbor, MI, USA (12 Dec 1983).

The Polarized Proton Sub-Group discussed the feasibility of a polarized proton capability in the SSC, and the additional machine requirements that would be necessary. Although the 10^3 extrapolation from present polarized proton accelerator energies requires caution in any recommendations, in our brief study we found no problems that would preclude obtaining polarized colliding beams in the SSC. Achieving polarization capability will require some restrictions on the machine design to allow the addition of perhaps 20 "Siberian Snakes" of about 18 Tesla-meters each to avoid beam depolarization; space for these snakes should be provided in the lattice. Vertical deflection of the beam should also be avoided if possible, since the resulting depolarization might be difficult to undo. Thus polarization would probably be in conflict with the vertical orbit distortion inherent in a "terrain following" SSC. Maintaining beam polarization during acceleration through the booster stages could be achieved with conventional resonance crossing methods such as pulsed quads, spin flips, correction dipoles, and snakes at the higher energies. An additional low energy accumulator ring booster system might be required to bring the polarized beam intensity up to the unpolarized beam level. Asymmetries in high-P_1 inclusive or elastic reactions are potential candidates for polarimeters at multi-TeV energies.

31922 (UM-HE—84-1, pp 67-68) **Note on reversible dispersion matching with arbitrary phase advance.** Helm, R.H. (Stanford Univ., CA). 1984. NTIS, PC A09/MF A01. File Number DE85004602. (CONF-831264—Summ.). Contract AC03-76SF00515.

From Workshop on accelerator physics issues for a superconducting super collider; Ann Arbor, MI, USA (12 Dec 1983).

This note describes a reversible dispersion matching system with arbitrary phase advance per cell. Reversible means that the match is independent of the sign of the quadrupoles. The method includes several well-known missing-magnet and reduced-magnet schemes as special cases.

31923 (UM-HE—84-1, pp 69-72) **LHC insertions with offset quadrupoles.** Hutton, A. (European Organization for Nuclear Research, Geneva, Switzerland). 1984. NTIS, PC A09/MF A01. File Number DE85004602. (CONF-831264—Summ.).

From Workshop on accelerator physics issues for a superconducting super collider; Ann Arbor, MI, USA (12 Dec 1983).

A new style of insertion for proton-proton colliders is proposed. By offsetting the quadrupoles, they can be used both for focusing and for separating the beams. This insertion can provide at least twice the luminosity of that of the previous proposals.

31924 (UM-HE—84-1, pp 78-82) **SSC closed-orbit correction.** Moore, C.; Murphy, T.; Norem, J.; Zisman, M. (Fermi National Accelerator Lab., Batavia, IL; Argonne National Lab., IL; Lawrence Berkeley Lab., CA). 1984. NTIS, PC A09/MF A01. File Number DE85004602. (CONF-831264—Summ.). Contract W-31-109-ENG-38;AC02-76CH03000;AC03-76SF00098.

From Workshop on accelerator physics issues for a superconducting super collider; Ann Arbor, MI, USA (12 Dec 1983).

Because of its large size (~ 100 km circumference), survey, alignment, and closed-orbit correction of the SSC will be challenging tasks. For example, the fact that the accelerator will have as small a magnet aperture as practicable means that the closed-orbit corrections must be very precise. A preliminary estimate, however, suggested that the closed-orbit errors may be quite large and difficult to correct properly. In this paper we attempt to estimate the expected magnitude of closed-orbit errors in the SSC, and the corrector strengths required to compensate for them. Formulae for closed-orbit deviations are parametrized here in such a way that they can be applied easily to the various lattice examples that presently exist and to those that will undoubtedly be generated in the future. To give a feeling for the magnitude of the various terms, a few numerical examples based on the 6.5 T LBL lattice are presented. Scaling to other "personal favorites" should be straightforward. Recent experience at Fermilab concerning the alignment and closed-orbit correction scheme in the Energy Saver/Doubler are discussed as a guide to the practical aspects of what can be achieved at an operating superconducting accelerator.

31925 (UM-HE—84-1, pp 119-123) **Conductor placement errors to Tevatron dipoles and quadrupoles and an extrapolation to SSC dipoles.** Fisk, H.E. (Fermi National Accelerator Lab., Batavia, IL). 1984. NTIS, PC A09/MF A01. File Number DE85004602. (CONF-831264—Summ.).

From Workshop on accelerator physics issues for a superconducting super collider; Ann Arbor, MI, USA (12 Dec 1983).

Multipole rms moments are calculated for angular displacements of conductor blocks for ironless dipoles and quadrupoles. Under the assumption that two rms angles are important, one for coil matching and one for overall angular deviation, the sigmas of the lower harmonic moments for Energy Doubler/Saver magnets can be compared. The conclusion is that coil matching is done to an accuracy of 0.5 to 0.75 mr (1.0 to 1.5 mils) and that conductor blocks are placed to 0.85 to 1.4 mr in angle (1.7 to 2.5 mils). If, in reducing the radius of the conductors for an SSC magnet, the angular placement errors are comparable, then the SSC moment distributions will also be comparable at 2/3 of the inner conductor radius.

31926 (UM-HE—84-1, pp 124-125) **Calculations of the dynamic aperture at the Tevatron.** Gelfand, N.M. (Fermi National Accelerator Lab., Batavia, IL). 1984. NTIS, PC A09/MF A01. File Number DE85004602. (CONF-831264—Summ.).

From Workshop on accelerator physics issues for a superconducting super collider; Ann Arbor, MI, USA (12 Dec 1983).

The dynamic aperture of the Tevatron has been calculated using the tracking program TEVLAT written by A. Russell. It is possible within TEVLAT to specify the magnetic coefficients up to b_8 and a_8 for each individual dipole and quadrupole in the lattice. In the case of dipoles the higher moments up to n = 14 are approximated, in calculating the non-linear effects, by the average values over all the dipoles. (This constraint is imposed by the limits on the available memory in the Fermilab Cyber. We do not believe that this approximation affects the results presented here.) Because TEVLAT allows the low order moments to be specified for each magnet individually it is possible to use the MTF measurements on the magnets and study the effect the ordering of the magnets in the lattice has on the dynamic aperture. 4 figs.

31927 (UM-HE—84-1, pp 139-143) **Estimate of the longitudinal and transverse impedances for the superconducting super collider.** Ng, K.Y. (Fermi National Accelerator Lab., Batavia, IL). 1984. NTIS, PC A09/MF A01. File Number DE85004602. (CONF-831264—Summ.).

From Workshop on accelerator physics issues for a superconducting super collider; Ann Arbor, MI, USA (12 Dec 1983).

We try to estimate the longitudinal impedance per harmonic Z/sub L//n as well as the transverse impedance Z/sub T/ for the 20 TeV Superconducting Super Collider (SSC). Effects due to space charge, wall resistivity, bellows, monitor plates, and synchrotron radiation are considered. The resulting Z/sub L//n and Z/sub T/ are plotted. Such a knowledge of z/sub L//n and Z/sub T/ is necessary in computing the limits of many types of instabilities for the bunched beam. To be more specific, in our estimation, we consider the special case of an injection energy of 1 TeV and assume a maximum field of 5 Tesla in the SSC dipoles, or E (maximum) = 20 TeV, γ/sub P/ (maximum) = 21315.6, E (injection) = 1 TeV, γ/sub P/ (injection) = 1065.78, B = 5T, rho = radius of curvature = 13.345 km. Our results show that when monitor plates matched at both ends (such as the ones used in the Tevatron) are used, their effects dominate both Z/sub L//n and Z/sub T/.

31928 (UM-HE—84-1, pp 147-148) **How much random sextupole field can we have in the presence of beam-beam interactions.** Ohnuma, S. (Fermi National Accelerator Lab., Batavia, IL). 1984. NTIS, PC A09/MF A01. File Number DE85004602. (CONF-831264—Summ.).

From Workshop on accelerator physics issues for a superconducting super collider; Ann Arbor, MI, USA (12 Dec 1983).

During the workshop, two estimates of the random sextupole components in the SSC dipoles have been presented, one from Berkeley and the other from Brookhaven. In the CERN SPS, beam studies on the anti p lifetime have been performed with p and anti p bunches separated by means of electrostatic separators. We may conclude that, if the beam-beam interaction is comparable in the SPS and SSC (that is, linear tune shift = .003/interaction, total 0.2), the SSC at 20 TeV with the Berkeley sextupole errors seem safe. The Brookhaven sextupole errors may be on the borderline.

31929 (UM-HE—84-1, pp 149-150) **Width of nonlinear resonance.** Ohnuma, S. (Fermi National Accelerator Lab., Batavia, IL). 1984. NTIS, PC A09/MF A01. File Number DE85004602. (CONF-831264—Summ.).

From Workshop on accelerator physics issues for a superconducting super collider; Ann Arbor, MI, USA (12 Dec 1983).

Two approximations are made, one essential and the other not so essential but convenient to keep the analytical treatment manageable: (1) only one nonlinear resonance is considered at a time so that the treatment is best suited when the tune is close to one resonance only. To improve this approximation, one must go to the next order which involves a canonical transformation of dynamical variables. Analytical treatment of more than one resonance is not possible for general cases; (2) in the formalism using the action-angle variables, the Hamiltonian can have terms which are independent of the angle variables. These terms are called "phase-independent terms" or "shear terms." The tune is then a function of the oscillation amplitudes.

31930 (UM-HE—84-1, pp 161-165) **Determination of the dynamic aperture of circular accelerators by the perturbation theory method.** Willeke, F. (Fermilab, Batavia, IL). 1984. NTIS, PC A09/MF A01. File Number DE85004602. (CONF-831264—Summ.).

From Workshop on accelerator physics issues for a superconducting super collider; Ann Arbor, MI, USA (12 Dec 1983).

An analytical method for finding the dynamic aperture is presented, which is based on the canonical perturbation theory. The nonlinear Hamilton function is transformed resulting in terms of 3rd order in the nonlinear field keeping only the detuning terms in first and second order. The new Hamilton function is constant if the third order terms are neglected. The phase trajectories resulting from the constant hamiltonian are transformed back into the original coordinates x, x′, y, y′. The dynamic aperture is extracted from the maximum linear phase ellipse which fits in the distorted phase areas. The procedure is applied to two examples, the TEVATRON and the SSC.

31931 (UM-HE—84-1, pp 166) **Aperture requirements for the beam position monitor and closed orbit distortions.** Shafer, R. (Fermi National Accelerator Lab., Batavia, IL). 1984. NTIS, PC A09/MF A01. File Number DE85004602. (CONF-831264—Summ.).

From Workshop on accelerator physics issues for a superconducting super collider; Ann Arbor, MI, USA (12 Dec 1983).

We assume that a beam position monitor (BPM) system comparable to the system installed in the Tevatron could be used for the 20 TeV rings. In brief, the Tevatron BPM used directionally sensitive transmission line type pickups which are capable of measuring the position of a single bunch of about 3 x 10^9 protons to +-300 microns on a single pass. The BPM system also provides beam intensity information simultaneously. The basic operating principle is for the signals from the passing beam bunch to shock excite bandpass filters (Q about 10) which ring for a sufficient number of cycles to allow measurement of the relative signal amplitudes by means of amplitude-to-phase conversion. The period of the oscillation should be equal to, or a harmonic of the bunch spacing. Unlike electrostatic pickups, this design is non-resonant and therefore presents a minimal relatively flat (z/n) to the beam.

31932 (UM-HE—84-1, pp 171) **Note on aperture limits from collective instabilities.** Keil, E. (CERN, Geneva, Switzerland). 1984. NTIS, PC A09/MF A01. File Number DE85004602. (CONF-831264—Summ.).

From Workshop on accelerator physics issues for a superconducting super collider; Ann Arbor, MI, USA (12 Dec 1983).

The calculation covers transverse and longitudinal microwave instability, and transverse mode coupling instability. (GHT)

31933 (UM-HE—84-1, pp 176-180) **RF noise considerations for the superconducting super collider.** Chattopadhyay, S. (CERN, Geneva, Switzerland). 1984. NTIS, PC A09/MF A01. File Number DE85004602. (CONF-831264—Summ.).

From Workshop on accelerator physics issues for a superconducting super collider; Ann Arbor, MI, USA (12 Dec 1983).

The purpose of this note is to provide a preliminary study of some scaling laws and relevant criteria, based on some already existing analyses, for the RF noise and feedback effects, that may affect the beam life-time and its stability properties in large hadron colliders like the SSC. Experience at the only operating hadron collider at present, Sp anti pS at CERN, provides the necessary theoretical and experimental data-base potentially capable of extension to higher energy rings as the 20 TeV SSC.

31934 **(LA-tr—85-21) RFQ-funneling.** Schempp, A. (Los Alamos National Lab., NM (USA); Frankfurt Univ. (Germany, F.R.). Inst. fuer Angewandte Physik). 1985. Contract W-7405-ENG-36. Translation of Int. Rep. 85-6, February 1985. 11p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85012483.

Funneling is the joining of beams in a zipper arrangement while doubling the frequency in order to increase the beam current, i.e., to utilize the acceptance of the linear accelerator even at the higher frequency. In projects such as the HIF and the SNQ, funneling is necessary in order to obtain higher current, i.e. higher brillance. No experiments have been conducted in this area up to now although it is one of the prerequisites for the realization of this high-current accelerator. Bongardt has presented the only theoretical concept in a long time, while Sarstedt has prepared some foundation for an experiment at our Laboratory. In this report, several divergent ideas on funneling are compiled.

31935 **Ultrahigh gradient particle acceleration by intense laser-driven plasma density waves.** Joshi, C.; Mori, W.B.; Katsouleas, T.; Dawson, J.M. (California Univ., Los Angeles (USA)); Kindel, J.M.; Forslund, D.W. (Los Alamos National Lab., NM (USA)). *Nature (London);* **311:** No. 5986, 525-529(11 Oct 1984).

Space-charge waves driven by resonantly beating two laser beams in a high-density plasma can produce ultrahigh electric fields that propagate with velocities close to c. By phase-locking particles in such a wave, particles may be accelerated to very high energies within a very short distance.

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REFER ALSO TO CITATION(S) 31739, 31759, 32005, 32027, 32035, 32044, 32487, 33037

31936 **(BNL—36417) Applications of decelerated ions.** Johnson, B.M. (Brookhaven National Lab., Upton, NY (USA)). Mar 1985. Contract AC02-76CH00016. 7p. (CONF-8410172—10). NTIS, PC A02/MF A01; GPO Dep. File Number DE85011832.

From Symposium of northeastern accelerator personnel; Stony Brook, NY, USA (15 Oct 1984).

Many facilities whose sole purpose had been to accelerate ion beams are now becoming decelerators as well. The development and current status of accel-decel operations is reviewed here. Applications of decelerated ions in atomic physics experiments are discussed.

31937 **(BNL—36450) Separated K^- beams (10 GeV and above).** Bunce, G.M. (Brookhaven National Lab., Upton, NY (USA)). 1985. Contract AC02-76CH00016. 4p. (CONF-8504133—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE85012527.

From International conference on hadron spectroscopy; College Park, MD, USA (20 Apr 1985).

Proton intensities now available at the AGS are considerably higher than just a few years ago and there are steps planned which should increase the accelerated intensities by a factor of four or more by 1988/89. Longer term plans would introduce a stretcher ring to allow for rapid pulsing of the AGS with a continuous spill. The LAMPF II proposal, if approved, would offer still more protons. Separated kaon beams with intensity similar to our present pion beams are, in fact, possible to build now, with the potential of even high kaon flux in the future. It is particularly attractive to work with a kaon minus beam due to the large number of final state combinations which would be available, due to the strange quark. Pion beams, being made of the same quarks as targets, are not so enticing. And yet our spectroscopy has so far been dominated by the pion results; kaon experiments have been more difficult with a factor of 50 to 100 lower intensity, and separated beams have only been possible up to about 6 GeV/c. The exception here is the rf-separated beam at CERN (and earlier rf-separated beams to bubble chambers at CERN and BNL). In the AGS-II Task Force Report, Cason and Donoghue showed that a kaon beam combined with a complete spectrometer capable of observing both neutral and charged particles would increase the available states for spectroscopy for masses from 1 to 3 GeV by a factor of 10. They urged a complete mapping of states, using a sky survey as an analogy. Our present capability is similar to scans of the sky made only in the optical range. They also point out that the specific subject of confinement - whether there can be combinations of quarks and gluons not yet seen - is an exciting topic which is beginning to get theoretical guidance from QCD calculations on a lattice. This confluence of technical advance (intensity) and physics interest (confinement) makes a separated kaon beam particularly compelling. 9 refs.

31938 **(BNL—36454) High vacuum portable pumping station suitable for accelerator use.** Stattel, P.; Briggs, J.; DeBoer, W.; Skelton, R. (Brookhaven National Lab., Upton, NY (USA)). 1985. Contract AC02-76CH00016. 3p. (CONF-850504—35). NTIS, PC A02/MF A01; GPO Dep. File Number DE85011840.

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

The need for a Portable Pump Station for Ultra High Vacuum use became apparent when the "Isabelle" collider was first being designed. A Portable Pump Station had to be developed which contained the following features: maneuverability, compact size, rugged, self protected against various failures, capable of running unattended, and capable of reaching 10^{-9} torr. The Pump Station that was developed and other variations are the subject of this paper. Emphasis will be on the Isabelle and HITL versions. 1 ref., 2 figs., 1 tab.

31939 **(BNL—36479) Tuning system for capacitively loaded 1/4 accelerating cavity.** McKenzie-Wilson, R.B. (Brookhaven National Lab., Upton, NY (USA)). 1985. Contract AC02-76CH00016. 3p. (CONF-850504—81). NTIS, PC A02/MF A01; GPO Dep. File Number DE85012516.

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

The Brookhaven National Laboratory NSLS x-ray and vuv rings currently use capacitively loaded $\lambda/4$ rf accelerating cavities. These cavities are manufactured from copper clad plate steel and require a tuning system with a considerable range. Three separate tuning systems are provided, each having its own specific problems and interactions occur between the three systems. A single capacitive tuning system is proposed which will vary the capacitance loading of the cavity directly. The system employs a vacuum balance mechanically driven diaphragm. The control system allows 6 mm of motion at a maximum slewing rate of 1.0 mm per sec and yields a dynamic tuning range of 480 kHz. Design and fabrication details will be presented together with early testing and operating experience.

31940 **(CONF-850504—36) Negative ion sources equipped with continuous annular and spherical geometry surface ionizers.** Alton, G.D.; Mills, G.D. (Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 5p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85011939.

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

Axial geometry negative ion sources have been designed, developed, and evaluated for use in conjunction with tandem accelerator applications. These sources utilize continuous surface solid tungsten ionizers in either annular or spherical geometries to effect ionization of cesium vapor, which in turn is used to sputter a negatively biased probe containing the material of interest. The annular ionizer geometry source has been incorporated as an "on-line" source for routine operation of the Holifield Heavy Ion Research Facility (HHIRF) tandem accelerator. Both test stand and tandem accelerator operational experience indicate that such sources are reliable, long lived, stably operating and prolific producers of a wide spectrum of negative ions. To date these sources have been used to produce more than 18 negative ion species including Ag^-, Au^-, B^-, CaH_3^-, Cl^-, CrH_2^-, Cu^-, Lu^-, MgH_3^-, Mo^-, Ni^-, O^-, S^-, Si^-, Sn^-, TiH_3^-, Tm^-, and Yb^-. Details of the mechanical design features and computational techniques utilized in arriving at the final electrode configuration are presented in the text. Examples of data pertinent to source operation, the dependence of negative ion yields on certain source operational parameters and of intensities typical of a particular negative ion source are also given. 12 refs., 10 figs.

31941 **(CONF-850504—117) Performance of the H^- ion source for the intense pulsed neutron source.** Stipp, V.; DeWitt, A. (Argonne National Lab., IL (USA)). 1985. Contract W-31-109-ENG-38. 3p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85012368.

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

In January of 1983, a magnetron type H^- ion source was installed in the Intense Pulse Neutron Source (IPNS) at Argonne National Laboratory. The higher available H^- current has helped enable the weekly average intensity of the Rapid Cycling Synchrotron (RCS) to be increased from 8 μA to over 12 μA. After two years of operation, the reliability of the source producing 40 mA of H^- ions at a 30 Hz repetition rate continues to be excellent.

31942 **(FNAL-TM—1307) Design considerations for personnel access penetrations for the superconducting super collider.** Cossairt, J.D. (Fermi National Accelerator Lab., Batavia, IL (USA)). Apr 1985. Contract AC02-76CH03000. 13p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85013027.

The detailed design of the tunnel for the SSC will, hopefully, soon begin. In this note are documented some considerations concerning the design of the radiological shielding for personnel access labyrinths. The methods are standard ones used at Fermilab, most recently described in detail (along with experimental results) in a paper by Cossairt, et al. In the present paper a conceptual design is presented which will provide the required amount of protection for use of the SSC both as a pure collider and as an accelerator used for a fixed-target experimental program. A recipe will be developed which will allow designers to adjust these calculations for small deviations from this conceptual design.

31943 **(GANIL-P—84-10) LISE: a new spectrometer at GANIL for physics on exotic nuclei.** Mueller, A.C. (Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France)). Sep 1984. 7p. (CONF-8409143—11). NTIS (US Sales Only), PC A02/MF A01. File Number DE85751329.

From 7. international conference on atomic masses and fundamental constants (AMCO-7); Darmstadt-Seeheim, F.R. Germany (3 Sep 1984).

The new accelerator facility GANIL at Caen is devoted to heavy-ion physics in the intermediate-energy range 20-100 MeV/A. Due to the construction principle, a compact injector cyclotron followed by two "identical" isochronous sector cyclotrons coupled together by intermediate charge stripping, the accelerated beams are produced in relatively highly charged states. Therefore, little additional stripping is required in order to produce fully "naked" or hydrogen- and helium-like heavy species which are of great actual interest in atomic physics. This gave origin to the project "LISE" (Ligne d'Ions Super-Epluches), a special beam-line, consisting of a stripper and a magnetic analyser in order to produce and to separate the high-charge states and to provide them in form of beams of high optical quality. From the beginning it was also specified that this instrument, with some additional adaptations would serve as well for physics on nuclei far from stability. In the following LISE shall be described and first experimental progress reported.

31944 **(GSI—84-17) Studies on the feasibility of heavy ion beams for inertial confinement fusion.** (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Oct 1984. 134p. (CONF-840142—15). NTIS (US Sales Only), PC A07/MF A01. File Number DE85751124.

From International symposium on heavy ion accelerators and their applications to inertial fusion; Tokyo, Japan (23 Jan 1984).

This reports contains some articles contributed to the named conference. These concern the heavy ion fusion program of the Federal Republic of Germany, heavy ion accelerators, the HIBALL projects, storage rings for heavy ion beams, transport of heavy ion beams, and target projects for fusion applications. 43 references.

31945 **(IFVE-OEA-OKU—83-183) Manual timer.** Lebedev, O.P.; Serebryakov, V.I.; Tishin, V.G. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1983. 11p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85701065.

A manual timer operating in the IHEP accelerator synchronizing system is described. The manual timer comprises the reference frequency oscillator, frequency divider, timing counters, switches, coincidence circuits, D-triggers, pulse selection units, operating mode control unit, applifiers- pulse shapers, display and control unit, power supply unit. The device is characterized by low power consumption, compact, flexibility in monitoring and well-developed control means. The errors in time-interval generation and test results are being analyzed.

31946 **(IPNO-GEPL—83-09) CANAL code.** Gara, P.; Martin, E. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). 1983. 74p. (In French). NTIS (US Sales Only), PC A04/MF A01. File Number DE85751325.

The CANAL code presented here optimizes a realistic iron free extraction channel which has to provide a given transversal magnetic field law in the median plane: the current bars may be curved, have finite lengths and cooling ducts and move in a restricted transversal area; terminal connectors may be added, images of the bars in pole pieces may be included. A special option optimizes a real set of circular coils.

31947 **(JINR-R—9-83-920) Conditions for electron beam matched injection in collective accelerator adgezator.** Kazarinov, N.Yu.; Shcheulin, A.S. (Joint Inst. for Nuclear Research, Dubna (USSR). Dept. of New Acceleration Methods). 1983. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85701066.

The possibility of one-turn matched injection of the electron beam which has finite emittance and momentum spread into adgezator of the collective accelerator is considered. The ratios between the momentum of distribution function and that of dispersion and β-functions are found. It is shown that with a definite choice of geometry of electromagnetic field trajectory corrector matched injection can be achieved. The adgezator acceptance is found with making allowance of the influence of space charge forces. It is shown that with field index 0.22 and electron energy 2 MeV there is a possibility to form in the adgezator electron rings with electron number 10^{13} and momentum spread 100%-3% at small dimensions of the ring not more than 2 cm.

31948 (KEK—82-14, pp 157-158) **Production of secondary ions by heavy-ion bombardment of rare-gas targets.** Tonuma, T.; Kase, M.; Matsuo, T.; Urakawa, J.; Takahashi, J.; Kumagai, H.; Kambara, T.; Kohno, I. (Institute of Physical and Chemical Research, Wako, Saitama (Japan)). Jan 1983. (In Japanese). NTIS (US Sales Only), PC A11/MF A01. File Number DE85781031. (CONF-8208206—Summ.).

From 7. meeting on linear accelerators; Oho, Ibaraki, Japan (24 Aug 1982).

Published in summary form only.

31949 (KEK—82-14, pp 39-41) **Production of various ions with PIC type ion source at RIKEN Heavy Ion Linac.** Kase, M.; Miyazawa, Y.; Hemmi, M.; Chiba, T. (Institute of Physical and Chemical Research, Wako, Saitama (Japan)). Jan 1983. (In Japanese). NTIS (US Sales Only), PC A11/MF A01. File Number DE85781031. (CONF-8208206—Summ.).

From 7. meeting on linear accelerators; Oho, Ibaraki, Japan (24 Aug 1982).

Published in summary form only.

31950 (KEK—82-14, pp 147-148) **ECR heavy ion source for linac, (1).** Yanokura, Minoru (Institute of Physical and Chemical Research, Wako, Saitama (Japan)). Jan 1983. (In Japanese). NTIS (US Sales Only), PC A11/MF A01. File Number DE85781031. (CONF-8208206—Summ.).

From 7. meeting on linear accelerators; Oho, Ibaraki, Japan (24 Aug 1982).

Published in summary form only.

31951 (KEK—82-14, pp 212-214) **Secondary electron profile monitor.** Kobayashi, T.; Ueda, T.; Kobayashi, H.; Tabata, Y. (Tokyo Univ., Tokai, Ibaraki (Japan). Nuclear Engineering Research Lab.). Jan 1983. (In Japanese). NTIS (US Sales Only), PC A11/MF A01. File Number DE85781031. (CONF-8208206—Summ.).

From 7. meeting on linear accelerators; Oho, Ibaraki, Japan (24 Aug 1982).

Published in summary form only.

31952 (KEK—82-14, pp 215-217) **Beam bunch probes of RIKEN heavy ion LINAC.** Kase, M. (Institute of Physical and Chemical Research, Wako, Saitama (Japan)). Jan 1983. (In Japanese). NTIS (US Sales Only), PC A11/MF A01. File Number DE85781031. (CONF-8208206—Summ.).

From 7. meeting on linear accelerators; Oho, Ibaraki, Japan (24 Aug 1982).

Published in summary form only.

31953 (KEK—82-14, pp 218-220) **Beam profile monitor using Cerenkov light.** Tsumori, K.; Takeda, S.; Kawanishi, M. (Osaka Univ., Suita (Japan). Inst. of Scientific and Industrial Research); Suemine, S. Jan 1983. (In Japanese). NTIS (US Sales Only), PC A11/MF A01. File Number DE85781031. (CONF-8208206—Summ.).

From 7. meeting on linear accelerators; Oho, Ibaraki, Japan (24 Aug 1982).

Published in summary form only.

31954 (KEK—82-14, pp 185-187) **Phasing in PF linac.** Saito, Y.; Anami, S.; Fukuda, S.; Shidara, T.; Honma, H.; Nakao, K.; Tanaka, J. (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)). Jan 1983. (In Japanese). NTIS (US Sales Only), PC A11/MF A01. File Number DE85781031. (CONF-8208206—Summ.).

From 7. meeting on linear accelerators; Oho, Ibaraki, Japan (24 Aug 1982).

Published in summary form only.

31955 (KEK—82-14, pp 209-211) **Beam loss monitoring system for 2.5GeV electron Linac.** Nakagawa, H.; Shibata, S.; Katsura, T.; Enomoto, S.; Sato, I. (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)). Jan 1983. (In Japanese). NTIS (US Sales Only), PC A11/MF A01. File Number DE85781031. (CONF-8208206—Summ.).

From 7. meeting on linear accelerators; Oho, Ibaraki, Japan (24 Aug 1982).

Published in summary form only.

31956 (KEK—82-14, pp 229-231) **4π-mode acceleration in the KEK 20 MeV linac.** Kato, T.; Igarashi, Z.; Ikegami, K.; Kubora, C.; Takagi, A.; Takasaki, E.; Takenaka, T.; Mori, Y.; Fukumoto, S. (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)). Jan 1983. (In Japanese). NTIS (US Sales Only), PC A11/MF A01. File Number DE85781031. (CONF-8208206—Summ.).

From 7. meeting on linear accelerators; Oho, Ibaraki, Japan (24 Aug 1982).

Published in summary form only.

31957 (KEK—82-14, pp 235-237) **Focusing system of the PF 2.5 GeV linac and its operation.** Enomoto, A.; Takeda, K.; Matsumoto, H. (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)). Jan 1983. (In Japanese). NTIS (US Sales Only), PC A11/MF A01. File Number DE85781031. (CONF-8208206—Summ.).

From 7. meeting on linear accelerators; Oho, Ibaraki, Japan (24 Aug 1982).

Published in summary form only.

31958 (KEK—82-14, pp 29-31) **Studies on electron injector of linac for picosecond single pulse, (1).** Kobayashi, H.; Ueda, T.; Kobayashi, T.; Tabata, Y. (Tokyo Univ. (Japan). Faculty of Engineering). Jan 1983. (In Japanese). NTIS (US Sales Only), PC A11/MF A01. File Number DE85781031. (CONF-8208206—Summ.).

From 7. meeting on linear accelerators; Oho, Ibaraki, Japan (24 Aug 1982).

Published in summary form only.

31959 (KEK—82-14, pp 32-34) **Beam bunching in the PF linac injector.** Ohsawa, S.; Asami, A.; Tanaka, J. (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)). Jan 1983. (In Japanese). NTIS (US Sales Only), PC A11/MF A01. File Number DE85781031. (CONF-8208206—Summ.).

From 7. meeting on linear accelerators; Oho, Ibaraki, Japan (24 Aug 1982).

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31960 (KEK—82-14, pp 35-38) **Wake field generated by a high-current single bunch.** Takeda, Seishi; Kimura, Norio; Tsumori, Kunihiko; Kawanishi, Masaharu (Osaka Univ., Suita (Japan). Inst. of Scientific and Industrial Research). Jan 1983. (In Japanese). NTIS (US Sales Only), PC A11/MF A01. File Number DE85781031. (CONF-8208206—Summ.).

From 7. meeting on linear accelerators; Oho, Ibaraki, Japan (24 Aug 1982).

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31961 (KEK—82-14, pp 52-55) **PF 2.5 GeV linac accelerator tube fabrication.** Iino, Y.; Andoh, S.; Fujiwara, S.; Satoh, I. (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)); Takahashi, K.; Matsumoto, H. Jan 1983. (In Japanese). NTIS (US Sales Only), PC A11/MF A01. File Number DE85781031. (CONF-8208206—Summ.).

From 7. meeting on linear accelerators; Oho, Ibaraki, Japan (24 Aug 1982).

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31962 (KEK—82-14, pp 61-63) **Energy gain of the PF 2.5 GeV linac.** Enomoto, A.; Matsumoto, H.; Sato, I.; Takeda, K. (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)); Yamaguchi, N.; Iino, Y.; Taki, H. Jan 1983. (In Japanese). NTIS (US Sales Only), PC A11/MF A01. File Number DE85781031. (CONF-8208206—Summ.).

From 7. meeting on linear accelerators; Oho, Ibaraki, Japan (24 Aug 1982).

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31963 (KEK—82-14, pp 64-66) **Beam blow up in the PF 2.5 GeV linac.** Enomoto, A.; Takeda, K.; Matsumoto, H.; Sato, I. (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)); Oyamada, M. Jan 1983. (In Japanese). NTIS (US Sales Only), PC A11/MF A01. File Number DE85781031. (CONF-8208206—Summ.).

From 7. meeting on linear accelerators; Oho, Ibaraki, Japan (24 Aug 1982).

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31964 (KEK—82-14, pp 71-72) **Present status of the RF source of the Photon Factory injector linac.** Shidara, T.; Anami, S.; Fukuda, S.; Saito, Y.; Honma, H.; Nakao, K.; Tanaka, J. (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)). Jan 1983. (In Japanese). NTIS (US Sales Only), PC A11/MF A01. File Number DE85781031. (CONF-8208206—Summ.).

From 7. meeting on linear accelerators; Oho, Ibaraki, Japan (24 Aug 1982).

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31965 (KEK—82-14, pp 73-75) **Nanosecond electron gun with a compact cathode pulser.** Hosono, Y.; Hasegawa, K. (Tokyo Univ. (Japan). Faculty of Engineering); Asami, A.; Ohsawa, S. Jan 1983. (In Japanese). NTIS (US Sales Only), PC A11/MF A01. File Number DE85781031. (CONF-8208206—Summ.).

From 7. meeting on linear accelerators; Oho, Ibaraki, Japan (24 Aug 1982).

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31966 (KEK—82-14, pp 76-78) **Operation of PF injector throuch a minicomputer network.** Urano, T.; Otake, Y.; Abe, I.; Nakahara, K. (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)). Jan 1983. (In Japanese). NTIS (US Sales Only), PC A11/MF A01. File Number DE85781031. (CONF-8208206—Summ.).

From 7. meeting on linear accelerators; Oho, Ibaraki, Japan (24 Aug 1982).

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31967 (KEK—82-14, pp 84-86) **Microwave undulator.** Shintake, T.; Sato, I.; Kumabe, I. (Kyushu Univ., Fukuoka (Japan). Faculty of Engineering); Huke, K.; Tanaka, J. Jan 1983. NTIS (US Sales Only), PC A11/MF A01. File Number DE85781031. (CONF-8208206—Summ.).

From 7. meeting on linear accelerators; Oho, Ibaraki, Japan (24 Aug 1982).

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31968 (KEK—82-14, pp 89-91) **Observation of the beam structure in 20 MeV linac.** Igarashi, Z.; Kato, T.; Takasaki, E.; Fukumoto, S. (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)). Jan 1983. NTIS (US Sales Only), PC A11/MF A01. File Number DE85781031. (CONF-8208206—Summ.).

From 7. meeting on linear accelerators; Oho, Ibaraki, Japan (24 Aug 1982).

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31969 (KEK—82-14, pp 92-94) **Real time beam position monitor.** Yamamoto, T.; Tsumori, K.; Takeda, S.; Kawanishi, M. (Osaka Univ., Suita (Japan). Inst. of Scientific and Industrial Research). Jan 1983. (In Japanese). NTIS (US Sales Only), PC A11/MF A01. File Number DE85781031. (CONF-8208206—Summ.).

From 7. meeting on linear accelerators; Oho, Ibaraki, Japan (24 Aug 1982).

Published in summary form only.

31970 (KEK—82-14, pp 95-97) **Beam monitors in the transport line of the photon factory storage ring.** Katsura, T.; Nakagawa, H.; Shibata, S. (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)). Jan 1983. (In Japanese). NTIS (US Sales Only), PC A11/MF A01. File Number DE85781031. (CONF-8208206—Summ.).

From 7. meeting on linear accelerators; Oho, Ibaraki, Japan (24 Aug 1982).

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31971 (KEK—82-14, pp 98-100) **Design of PF beam-transport-line.** Kamiya, Y.; Kihara, M. (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)). Jan 1983. (In Japanese). NTIS (US Sales Only), PC A11/MF A01. File Number DE85781031. (CONF-8208206—Summ.).

From 7. meeting on linear accelerators; Oho, Ibaraki, Japan (24 Aug 1982).

Published in summary form only.

31972 (KEK—82-14, pp 115-119) **Proposed high-current injector for the Osaka University single bunch electron linear accelerator.** Takeda, Seishi; Tsumori, Kunihiko; Kimura, Norio; Yamamoto, Tamotsu; Sawai, Tomikazu; Ohkuma, Juzo; Hori, Toshihiko; Kawanishi, Masaharu (Osaka Univ., Suita (Japan). Inst. of Scientific and Industrial Research). Jan 1983. (In Japanese). NTIS (US Sales Only), PC A11/MF A01. File Number DE85781031. (CONF-8208206—Summ.).

From 7. meeting on linear accelerators; Oho, Ibaraki, Japan (24 Aug 1982).

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31973 (KEK—82-14, pp 123-125) **Positron generator linac.** Sato, I. (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)). Jan 1983. (In Japanese). NTIS (US Sales Only), PC A11/MF A01. File Number DE85781031. (CONF-8208206—Summ.).

From 7. meeting on linear accelerators; Oho, Ibaraki, Japan (24 Aug 1982).

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31974 (KEK—82-14, pp 126-128) **RF measurment of split-coaxial RFQ structure.** Katayama, Yuko; Takekoshi, Hidekuni (Kyoto Univ., Uji (Japan). Inst. for Chemical Research). Jan 1983. (In Japanese). NTIS (US Sales Only), PC A11/MF A01. File Number DE85781031. (CONF-8208206—Summ.).

From 7. meeting on linear accelerators; Oho, Ibaraki, Japan (24 Aug 1982).

Published in summary form only.

31975 (KEK—82-14, pp 138-140) **Beam test of a DAW acceleration structure.** Tanaka, T.; Tsukada, K.; Satoh, K.; Hayakawa, K.; Ozaki, T.; Nakamura, N.; Okamoto, K.; Takeda, O.; Nishinaka, M. (Nihon Univ., Tokyo. Atomic Energy Research Inst.). Jan 1983. (In Japanese). NTIS (US Sales Only), PC A11/MF A01. File Number DE85781031. (CONF-8208206—Summ.).

From 7. meeting on linear accelerators; Oho, Ibaraki, Japan (24 Aug 1982).

Published in summary form only.

31976 (KIYI—83-14, pp 9-11) **Software for the system of data transmission from the U-240 measuring center to the M-4030 computer.** Golovach, L.A.; Ofengenden, R.G. 1983. (In Russian). NTIS (US Sales Only), PC A03/MF A01. File Number DE85780969.

In Equipment for the nuclear and physical experiment on the isochronous cyclotron U-240 in 1982.

Multi-computer measurement-calculational complexes form the technical base of scientific experiment modern automation systems. One of possible approaches to software creation for the data transmission system in the framework of standard operational systems of all computers, included in the complex, is described. A more poweful M-4030 type computer should employ a data base. Hardcopy logs of interconnection are realized taking into account the hardware. A task from initiative peripheral interrupt a enters the M-4030 computer. The task is performed synchonously by the computers engaged. Exchange of data, input parameters and results proceeds via the data base.

31977 (**LA-UR—85-1584**) **Ion source development for the Los Alamos heavy ion fusion injector.** Rutkowski, H.L.; Oona, H.; Meyer, E.A.; Shurter, R.P.; Engelhardt, L.S.; Humphries, S. Jr. (Los Alamos National Lab., NM (USA); New Mexico Univ., Albuquerque (USA). Inst. for Accelerator and Plasma Beam Technology). 1985. Contract W-7405-ENG-36. 4p. (CONF-850504—152). NTIS, PC A02/MF A01; GPO Dep. File Number DE85012682.

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

A multi-beam injector is being designed and built at Los Alamos for the US Heavy Ion Fusion Program. As part of this program, development of an aluminum-spark, pulsed plasma source is being carried out. Faraday cup diagnostics are used to study current emission and to map the current profile. An aluminum oxide scintillator with photographic film is used in conjunction with a pepper-pot to obtain time integrated emittance values.

31978 **(LA-UR—85-1605) High-power, solid-state rf source for accelerator cavities.** Vaughan, D.R.; Mols, G.E.; Reid, D.W.; Potter, J.M. (Westinghouse Electric Corp., Baltimore, MD (USA). Defense and Electronics Center; Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 4p. (CONF-850504—63). NTIS, PC A02/MF A01; GPO Dep. File Number DE85012672.

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

During the past few years the Defense and Electronics Center of Westinghouse Electric Corporation has developed a solid-state, 250-kW peak, rf amplifier for use with the SPS-40 radar system. This system has a pulse length of 60 μs and operates across the frequency band from 400 to 450 MHz. Because of the potential use of such a system as an rf source for accelerator applications, a collaborative experiment was initiated between Los Alamos National Laboratory and Westinghouse to simulate the resonant load conditions of an accelerator cavity. This paper describes the positive results of that experiment as well as the solid-state amplifier architecture. It also explores the future of high-power, solid-state amplifiers as rf sources for accelerator structures.

31979 **(LA-UR—85-1611) Los Alamos free-electron laser.** Watson, J.M. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 6p. (CONF-850504—49). NTIS, PC A02/MF A01; GPO Dep. File Number DE85012666.

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

During the past year the Los Alamos free-electron laser (FEL) oscillator has demonstrated high peak and average power (10 MW and 6 kW), broad-wavelength tunability (9 to 35 μm), and near-ideal optical quality (0.9 Strehl ratio). An electron energy-extraction efficiency of 1% was measured. The predicted production of synchrotron sidebands also was observed in the broadened optical spectrum. As shorter wavelengths and higher powers are pursued, higher currents with improved beam quality will be required. Advanced injectors and energy-recovery systems are being developed to meet these demands. 17 refs., 6 figs., 3 tabs.

31980 **(LA-UR—85-1614) Los Alamos Proton Storage Ring fast-extraction kicker system.** Power, J.F.; Blind, B.; Jason, A.J. (Los Alamos National Lab., NM (USA)). May 1985. Contract W-7405-ENG-36. 4p. (CONF-850504—52). NTIS, PC A02/MF A01; GPO Dep. File Number DE85012663.

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

We describe the kicker system used by the Los Alamos Proton Storage Ring (PSR) for fast extraction of accumulated 800-MeV proton beam. The system has several severe constraints in terms of rise time, field quality, and magnet dimensions. These are, in turn, defined by characteristics of the stored beam, ring lattice, and the allowable activation of ring components. Design methods to meet the constraints are outlined here and we describe the novel modulators that produce the fast pulses required. 3 refs., 7 figs.

31981 **(LA-UR—85-1620) Ferrite kicker magnet for the LAMPF switchyard upgrade.** Hardekopf, R.A.; Higgins, E.F.; Lunsford, J.S. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 4p. (CONF-850504—60). NTIS, PC A02/MF A01; GPO Dep. File Number DE85012657.

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

The new LAMPF switchyard requires a kicker magnet as the first element in the transport line leading to the Proton Storage Ring (PSR). The magnet must produce 1-ms-long pulses with 40-μs rise time and <0.3% flat-top regulation to deflect the 800-MeV H^- beam by 1.2°. We have constructed two 1-m-long, single-turn ferrite magnets, each powered by a modulator supplying up to 2400 A at a maximum rate of 24 Hz. The modulators use a transistor amplifier/regulator, a dual pulse-forming-network (PFN), and a compensating circuit driven by a function generator to achieve a total 0.1% current variation in the pulse. The system also produces an alternate kicking mode consisting of 150-μs-long pulses at a maximum rate of 120 Hz; the two modes can be multiplexed within the charging power-supply limitations. 3 refs., 6 figs.

31982 **(LA-UR—85-1624) Optimizing data access in the LAMPF control system.** Schaller, S.C.; Corley, J.K.; Rose, P.A. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 4p. (CONF-850504—55). NTIS, PC A02/MF A01; GPO Dep. File Number DE85012653.

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

The LAMPF control system data access software offers considerable power and flexibility to application programs through symbolic device naming and an emphasis on hardware independence. This paper discusses optimizations aimed at improving the performance of the data access software while retaining these capabilities. The only aspects of the optimizations visible to the application programs are "vector devices" and "aggregate devices." A vector device accesses a set of hardware related data items through a single device name. Aggregate devices allow run-time optimization of references to groups of unrelated devices. Optimizations not visible on the application level include careful handling of: network message traffic; the sharing of global resources; and storage allocation.

31983 **(LA-UR—85-1640) Proposed bunching scheme for a polarized H^- injector.** Swain, G.R.; Browman, A.A. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 4p. (CONF-850504—48). NTIS, PC A02/MF A01; GPO Dep. File Number DE85012648.

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

Improvements to the polarized H^- injector at LAMPF will include a two-stage buncher and beam chopper. The buncher scheme will permit the compression of a major part of the current in 20 rf cycles of the drift-tube linac (100 nsec) into a single rf cycle (5 nsec), thus making possible time-of-flight experiments with the polarized H^- beam. A proposed first buncher stage would use a ramp drive waveform; the second stage, a sinusoidal waveform. Design and sensitivity calculations are summarized, including beam energy considerations, buncher and chopper drive requirements, and longitudinal and transverse beam dynamics. The calculations indicate that about 70% of the beam from the source may be bunched in the 1-nsec acceptance region of the linac, with less than 0.1% of the beam in neighboring rf cycles. 5 figs.

31984 **(LA-UR—85-1735) Recent advances in remote handling at LAMPF.** Lambert, J.E.; Grisham, D.L. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 4p. (CONF-850504—107). NTIS, PC A02/MF A01; GPO Dep. File Number DE85012725.

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

The Clinton P. Anderson Meson Physics Facility (LAMPF) has operated at beam currents above 200 microamperes since 1976. As a result, the main experimental beam line (Line A) has become increasingly radioactive over the years. Since 1976 the radiation levels have steadily increased from 100 mR/hr to levels that exceed 10,000 R/hr in the components near the pion production targets. During this time the LAMPF remote handling system, Monitor, has continued to operate successfully in the ever-increasing radiation levels, as well as with more complex remote-handling situations. This paper briefly describes the evolution of Monitor and specifically describes the complete rebuild of the A-6 target area, which is designated as the beam stop, but also includes isotope production capabilities and a primitive neutron irradiation facility. The new facility includes not only the beam stop and isotope production, but also facilities for proton irradiation and a ten-fold expansion in neutron irradiation facilities.

31985 (LA-UR—85-1736) **Major facility overhauls at LAMPF.** Grisham, D.L.; Lambert, J.E.; Sommer, W.F. Jr. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 4p. (CONF-850504—112). NTIS, PC A02/MF A01; GPO Dep. File Number DE85012724.

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

The Clinton P. Anderson Meson Physics Facility (LAMPF) is a linear proton accelerator designed to operate at 800 MeV and 1.0 mA. It has been operating at power levels above 200 microamperes since February of 1976 and now routinely operates near the design level. This paper outlines the problems encountered with the original target cell components, the repairs required since 1976, and specifically details the steps involved in the complete replacement of the vital target cell components. These components include target boxes, collimators, main beam line magnets, and the front-end magnets of the secondary beam lines. The A-2 target cell was replaced in the spring of 1983 and the A-1 target cell was replaced in the spring of 1984. Both have operated satisfactorily since their completion, with only minor difficulties. The overhaul and total component replacement in the beam stop area (A-6) was completed in early May 1985 and has just been placed in operation. The upgrade, in addition to the replacement of the beam stop and the vacuum-to-air window with state-of-the-art designs, provides a greatly increased capability of both proton and neutron irradiation of materials.

31986 (LA-UR—85-1737) **Beam line windows at LAMPF.** Brown, R.D.; Grisham, D.L.; Lambert, J.E. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 4p. (CONF-850504—113). NTIS, PC A02/MF A01; GPO Dep. File Number DE85012723.

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

The A-6 main beam-line window at LAMPF separates the vacuum of the main beam line from the isotope production station, proton irradiation ports, and the beam stop, which operate in air. This window must withstand the design beam current of 1 mA at 800 MeV for periods of at least 3000 hours without failure. The window is water cooled and must be strong enough to withstand the 2.1 MPa (300 psig) cooling water pressure, as well as beam-induced thermal stresses. Two designs have been used to meet these goals, a stepped-plate window and a hemispherical window, both made from a precipitation-hardened nickel base alloy, Alloy 718. Calculations of the temperatures and stresses in each of these windows are presented.

31987 (NAC-AR—84-01) **Annual report June 1984. [Council for Scientific and Industrial Research, Faure (South Africa). National Accelerator Centre].** (Council for Scientific and Industrial Research, Faure (South Africa). National Accelerator Centre). 1984. 308p. NTIS (US Sales Only), PC A14/MF A01. File Number DE85780939.

Abstracts of individual items from the report were prepared separately for the data base. (GHT)

31988 (SAND—84-2392C) **Automated magnet testing facility.** Lancaster, K.T.; Sharpe, A.W. (Sandia National Labs., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 11p. (CONF-850616—12). NTIS, PC A02/MF A01; GPO Dep. File Number DE85012863.

From 5. IEEE pulsed power conference; Washington, DC, USA (10 Jun 1985).

The automated Magnet Testing Facility (MTF) is a computer controlled, 60 kJ, parallel capacitor bank that was constructed to pulse test solenoidal magnets. Coil sets from different vendors were evaluated on two criteria: uniformity of field and coil reliability. The first criterion, uniformity of field, is evaluated by installing a pair of coils into stainless steel housings and pulse mapping the fields at a low energy level. Forty field-strength samples were easily collected with the one button operation of the MTF. Two thousand high field pulse tests, at a 20 kG level, is the second criterion for magnet acceptance. In a manually operated system a single operator can achieve this goal in six months. In a continuous operating mode, MTF can achieve the same goal in 42 days.

31989 (SAND—85-0039C) **New directional couplers for multimode circular waveguides applied to intense pulsed microwave systems.** Earley, L.M.; Ballard, W.P.; Wharton, C.B. (Sandia National Labs., Albuquerque, NM (USA); Cornell Univ., Ithaca, NY (USA). Lab. of Plasma Studies). 1985. Contract AC04-76DP00789. 4p. (CONF-850504—27). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85011753.

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

Three new types of directional couplers are described for use in overmoded circular waveguide operating in the TM_{01} mode. The types are (1) circular/rectangular waveguide multihole couplers, (2) circular waveguide/coaxial multihole couplers, and (3) circular waveguide loop couplers. These directional couplers are designed to diagnose intense pulsed microwave systems in the frequency range 3 to 18 GHz. Coupling coefficients vary between 50 dB and 70 dB with directivities between 13 dB and 20 dB. These devices have been used to measure the output powers of relativistic magnetrons and backward wave oscillators (BWOs) in the power range 100 MW to 300 MW.

31990 (SLAC-PUB—3610) **Solid state high power amplifier for driving the SLC injector klystron.** Judkins, J.G.; Clendenin, J.E.; Schwarz, H.D. (Stanford Linear Accelerator Center, CA (USA)). Mar 1985. Contract AC03-76SF00515. 3p. (CONF-850504—127). NTIS, PC A02/MF A01; GPO Dep. File Number DE85013063.

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

The SLC injector klystron rf drive is now provided by a recently developed solid-state amplifier. The high gain of the amplifier permits the use of a fast low-power electronic phase shifter. Thus the SLC computer control system can be used to shift the phase of the high-power rf rapidly during the fill time of the injector accelerator section. These rapid phase shifts are used to introduce a phase-energy relationship in the accelerated electron pulse in conjunction with the operation of the injector bunch compressor. The amplifier, the method of controlling the rf phase, and the operational characteristics of the system are described. 5 refs., 4 figs.

31991 (SLAC-PUB—3616) **Electron wind in strong wave guide fields.** Krienen, F. (Stanford Linear Accelerator Center, CA (USA)). Mar 1985. Contract AC03-76SF00515. 4p. (CONF-850504—110). NTIS, PC A02/MF A01; GPO Dep. File Number DE85013062.

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

The x-ray activity observed near highly powered wave guide structures is usually caused by local electric discharges originating from discontinuities such as couplers, tuners or bends. In traveling waves electrons are shown to move in the direction of the power flow. Seed electrons can multipactor in a traveling wave, the moving charge pattern is different from the multipactor in a resonant structure and is self-extinguishing. Given sufficient primary sources, the charge density in the wave guide will modify impedance and propagation constant of the wave guide. An estimate is made of the radiation level inside the output wave guide of the SLAC, 50 MW, S-band, klystron. Possible contributions of radiation to window failure are discussed.

31992 (SLAC-PUB—3632) **GIANT: a computer code for General Interactive ANalysis of Trajectories.** Jaeger, J.; Lee, M.; Servranckx, R.; Shoaee, H. (Stanford Linear Accelerator Center, CA (USA)). Apr 1985. Contract AC03-76SF00515. 3p. (CONF-850504—106). NTIS, PC A02/MF A01; GPO Dep. File Number DE85013058.

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

Many model-driven diagnostic and correction procedures have been developed at SLAC for the on-line computer controlled operation of SPEAR, PEP, the LINAC, and the Electron Damping Ring. In order to facilitate future applications and enhancements, these procedures are being collected into a single program, GIANT. The program allows interactive diagnosis as well as performance optimization of any beam transport line or circular machine. The test systems for GIANT are those of the SLC project. The organization of this program and some of the recent applications of the procedures will be described in this paper.

31993 (SLAC-PUB—3633) **Error message recording and reporting in the SLC control system.** Spencer, N.; Bogart, J.; Phinney, N.; Thompson, K. (Stanford Linear Accelerator Center, CA (USA)). Apr 1985. Contract AC03-76SF00515. 3p. (CONF-850504—84). NTIS, PC A02/MF A01; GPO Dep. File Number DE85013057.

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

Error or information messages that are signaled by control software either in the VAX host computer or the local microprocessor clusters are handled by a dedicated VAX process (PARANOIA). Messages are recorded on disk for further analysis and displayed at the appropriate console. Another VAX process (ERRLOG) can be used to sort, list and histogram various categories of messages. The functions performed by these processes and the algorithms used are discussed.

31994 (SLAC-PUB—3671) **High-resolution phosphor screen beam profile monitor.** Yencho, S.; Walz, D.R. (Stanford Linear Accelerator Center, CA (USA)). May 1985. Contract AC03-76SF00515. 4p. (CONF-850504—83). NTIS, PC A02/MF A01; GPO Dep. File Number DE85013074.

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

A high-resolution luminescent screen beam profile monitor was developed to allow viewing of both conventional large diameter SLAC e^+/e^- beams, and also collider rf-bunches having small transverse spatial extent, with one instrument. The principal features of the monitor are described. They include the two-power magnification system offering magnifications of 12 and 78X, respectively; the reticle grid which is optically superimposed on the screen image by a cube beam splitter; selection of a suitable camera; and the $Al_2O_3(Cr)$ phosphor screen. A simplified version of the monitor for viewing of only micron-sized beams for applications in the collider arcs and final focus regions and achieving a magnification of $\sim$ 40X, coupled with a resolution of $\sim 20\mu m$ is also presented. 4 refs., 4 figs.

31995 (SLAC-PUB—3689) **Increased intensity performance of the Brookhaven AGS.** Raka, E.; Ahrens, L.; Frey, W.; Gill, E.; Glenn, J.W.; Sanders, R.; Weng, W. (Stanford Linear Accelerator Center, CA (USA); Brookhaven National Lab., Upton, NY (USA)). May 1985. Contract AC03-76SF00515. 4p. (CONF-850504—71). NTIS, PC A02/MF A01; GPO Dep. File Number DE85013371.

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

With the advent of H^- injection into the Brookhaven AGS, circulating beams of up to 3×10^{13} protons at 200 MeV have been obtained. Rf capture of 2.2×10^{13} and acceleration of 1.73×10^{13} up to the transition energy ($\approx$ 8 GeV) and 1.64×10^{13} to full energy ($\approx$ 29 GeV) has been achieved. This represents a 50% increase over the best performance obtained with H^+ injection. The increase in circulation beam current is obtained without filling the horizontal aperture. This allows the rf capture process to utilize a larger longitudinal phase space area ($\approx$ 1 eV sec/bunch vs $\leqq$ 0.6 eV sec with H^+ operation). The resulting reduction in relative longitudinal density partially offsets the increase in space charge effects at higher currents. In order to make the capture process independent of injected beam current, a dynamic beam loading compensation loop was installed on the AGS rf system. This is the only addition to the synchrotron itself that was required to reach the new intensity records. A discussion of injection, the rf capture process, and space charge effects is presented. 9 refs., 5 figs.

31996 (SLAC-TN—84-1-Rev.) **Time domain reflectometry for SLC BPM system. Revision.** Thompson, D.R. (Stanford Linear Accelerator Center, CA (USA)). Mar 1985. Contract AC03-76SF00515. 36p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85012389.

This document is intended for use as a maintenance manual for troubleshooting installed SLC Beam Position Monitor stripline assemblies and the associated cabling, using Time Domain Reflectometry. Once a technician becomes familiar with this manual's procedures, the Table of Contents can serve as a checklist.

31997 (UM-HE—84-1, pp 73-77) **Injection, extraction and beam abort system for the SSC.** Leemann, B.T. (Univ. of California, Berkeley). 1984. NTIS, PC A09/MF A01. File Number DE85004602. (CONF-831264—Summ.). Contract AC03-76SF00098.

From Workshop on accelerator physics issues for a superconducting super collider; Ann Arbor, MI, USA (12 Dec 1983).

The subject of beam extraction and abortion from a 20 TeV accelerator has been explored by one working group at the 2nd ICFA workshop in 1979. This study concluded that the design of a fast extraction channel is relatively straightforward, and involves conventional extraction channel elements. Similarly, in a contribution to the present proceedings, Willie comes to the same conclusion with regard to a 1 TeV injection channel for the SSC. In this paper we demonstrate the feasibility of implementing injection and extraction channnels into the 6.5 Tesla sample lattice designed by Garren using hardware parameters as suggested. Finally, an attempt is made to estimate the required beam size at the beam dump and its consequences for the transfer line optics are considered. 6 refs., 6 figs., 2 tabs.

31998 (UM-HE—84-1, pp 93-94) **Some remarks on the injection into the SSC.** Wille, K. (Stanford Univ., CA). 1984. NTIS, PC A09/MF A01. File Number DE85004602. (CONF-831264—Summ.). Contract AC03-76SF00515.

From Workshop on accelerator physics issues for a superconducting super collider; Ann Arbor, MI, USA (12 Dec 1983).

For this study a high energy booster (HEB) with a 5T magnet type is chosen as figured out during the Cornell Workshop. This preaccelerator provides the main ring with 18 μs long chains of bunches containing a total number of 1.2×10^{13} particles each. A sequence of 18 such chains fits within the main ring if its circumference is supposed to be 100 km. With these values a total number of 2×10^{14} particles per beam should be possible. There are unavoidable gaps between the stored bunch chains because of the non zero lengths of the rising and falling edges of the kicker pulse. The length of these gaps is mainly determined by kicker tolerances which will be discussed next. Other arguments may come from the detector requirements. The injection energy is set to E/sub inj/ = 1 TeV according to the results of the Cornell Workshop. 1 ref., 2 figs., 1 tab.

31999 (UM-HE—84-1, pp 189-190) **Synchrotron-radiation in a superconducting super collider: optical considerations.** Rehn, V. (Naval Weapons Center, China Lake, CA). 1984. NTIS, PC A09/MF A01. File Number DE85004602. (CONF-831264—Summ.).

From Workshop on accelerator physics issues for a superconducting super collider; Ann Arbor, MI, USA (12 Dec 1983).

With the prospect of a significant synchroton-radiation (SR) power emission by the SSC (10 to 100 kW), it is evident that methods are needed to minimize the SR heat load on the cryogenic system. The estimated cost of 4.5K cooling capacity is about $500K/kW, and the estimated power required in operation is about 1 MW/kW. If the SR load can be absorbed at a much higher temperature, both these costs will be greatly reduced. Several schemes have been suggested for accomplishing this, all of which depend on an appropriate optical design to ensure that the SR is absorbed mainly at the designated higher-temperature absorbers. The purpose of this short paper is to indicate the optical considerations of importance in such an SR optical system. 9 refs., 2 figs.

32000 **Fermilab accumulator magnets vacuum chamber heating system.** Satti, J.A.; Lee, G.N. (Fermi National Accelerator Laboratory, Batavia, Illinois 60510). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* 3: No. 3, 1695-1698(May 1985).

The Fermi National Accelerator Laboratory (Fermilab) is building an accumulator ring to store antiprotons for high energy physics proton—antiproton collisions in the Tevatron accelerator. The accumulator ring, approximately 474 m in circumference, consists of many quadrupole and dipole magnets connected with stainless steel vacuum chambers for beam circulation. The vacuum pressure required is in the low 10^{-10} Torr range. To reach this pressure, the vacuum chambers are baked at 300 °C each time they have been opened to atmospheric pressure. The critical problem is to bake the chambers in the magnets at high temperature without overheating the laminated magnets. Some of the magnets are 5 m long with very restrictive space for the heaters and insulation. An average space of only 7.5 mm around the chambers is available. In this space a heating system has been designed and tested to heat the chamber to 300 °C and allow a maximum temperature of 65 °C next to the magnet components. This was accomplished by using a heating blanket completely covered with a water cooled copper heat sink jacket to protect the magnet from the high temperatures. The design of a final selected heating blanket is discussed. A prototype test results are given with comparison of calculated and measured temperature distribution.

32001 **Monitoring and calibration system for neutrino flux measurement in a high energy dichromatic beam.** Blair, R. (California Inst. of Tech., Pasadena (USA); Columbia Univ., New York (USA)); Jin, B. (California Inst. of Tech., Pasadena (USA); Academia Sinica, Beijing (China). Inst. of High Energy Physics); Macfarlane, D. (California Inst. of Tech., Pasadena (USA); Toronto Univ., Ontario (Canada)); Messner, R.L. (California Inst. of Tech., Pasadena (USA); Stanford Linear Accelerator Center, CA (USA)); Novikoff, D.B. (California Inst. of Tech., Pasadena (USA); Hughes Aircraft Co., El Segundo, CA (USA)). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **226**: No. 2/3, 281-300(Oct 1984).

In an experiment to measure the cross section for ν-N interactions, the neutrino flux is inferred from measured properties of the secondary hadron beam. The measurements of intensity, composition, and phase space are inputs to a Monte Carlo program which simulates the neutrino beam impinging on the experimental target detector. The components, technical design, and calibration of the devices which monitor the secondary beam are discussed. The accuracy with which the neutrino flux can be determined, given the limitations of the secondary beam monitoring, is also indicated.

32002 **Low-noise 2-4 GHz preamplifier.** Jackson, H.G.; Shimizu, T.T. (Lawrence Berkeley Lab., CA (USA)). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **226**: No. 2/3, 560-563(Oct 1984).

A low-noise preamplifier has been developed for use in stochastic beam cooling experiments. The preamplifier consists of a cascade of four GaAs field-effect transistors, and is made with lumped components.

32003 **Magnet-field design considerations for a high-energy superconducting cyclotron.** Botman, J.I.M.; Craddock, M.K.; Kost, C.J.; Richardson, J.R. (TRIUMPH, Vancouver, British Columbia). *International Conference on High Energy;* 1-3(Aug 1983). (CONF-830822—).

From 12. international conference on high energy accelerators; Batavia, IL, USA (11 Aug 1983).

This paper reports the pole shape designs for a two stage superconducting isochronous cyclotron combination (CANUCK) to accelerate 100 μA proton beams to 15 GeV. The pole shape of the 15 sectors of the first stage 3.5 GeV proton cyclotron provides isochronism over the full energy range and a constant axial tune over all but the lowest energies. Progress on the pole design of the 42-sector 15-GeV second stage is also reported. The magnetic fields are computed from the current distribution of the superconducting coils and the infinitely thin current sheets simulating the fully saturated poles. A least-squares method is used to minimize deviations from isochronism by adjusting the size of various elemental shim coils placed around the main coil. The method to obtain the desired axial tune is described. 13 references, 6 figures.

4304 Storage Rings

32004 **(BNL—36430) Saturation of a longitudinal instability due to nonlinearity of the wake field.** Krinsky, S. (Brookhaven National Lab., Upton, NY (USA)). 1985. Contract AC02-76CH00016. 3p. (CONF-850504—82). NTIS, PC A02/MF A01; GPO Dep. File Number DE85012514.

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

Self-sustained synchrotron oscillations are observed in electron storage rings. In general the theoretical description of the saturation of an instability for large oscillation amplitude is a difficult problem, and techniques have not yet been developed which yield analytic approximations to the appropriate nonlinear Vlasov or Fokker-Planck equations. In this paper, a single point bunch interacting with the wake field from a single resonant mode of an rf cavity is considered, and the averaging method of Bogoliubov and Mitropolsky is used to study the saturation of the initial exponential growth of the oscillation amplitude, due to the nonlinearity of the wake field. The determination of the limiting amplitude of oscillation is discussed both in the presence and in the absence of radiation damping.

32005 **(CONF-850504—43) Vacuum system for the Argonne 6 GeV synchrotron light source.** Wehrle, R.; Moenich, J. (Argonne National Lab., IL (USA)). 1985. Contract W-31-109-ENG-38. 3p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85012286.

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

The ANL vacuum system for the 6 GeV light source storage ring features non-evaporable strip getter pumps for uniform pumping around the ring within a gas desorption antechamber, and it also features lumped getter pumping directly under and above crotch radiation absorbers that are positioned after each bending magnet. Based on experiments at ANL in 1980 and by others, the technical and economical advantages have been established for the use of the distributed NeG pumps of non-magnetic strips coated with a non-evaporable Zr Al getter matrix. The NeG strip pump lifetime approaches ten years. The antechamber improves the isolation of the gas desorption process from the main beam chamber and beam. The combination of these vacuum techniques; the NeG strip getter pumps, the gas desorption antechambers, and the lumped ion and lumped getter pumping provide a unique and reliable system for maintaining long beam lifetime.

32006 **(LA-UR—85-1613) Los Alamos high-current proton storage ring: a status report.** Lawrence, G.P.; Hardekopf, R.A.; Jason, A.J.; Clout, P.N.; Sawyer, G.A. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 5p. (CONF-850504—51). NTIS, PC A02/MF A01; GPO Dep. File Number DE85012664.

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

The Proton Storage Ring (PSR), whose installation was recently completed at Los Alamos, is a fast-cycling high-current accumulator designed to produce intense 800 MeV proton pulses for driving a spallation neutron source. The ring converts long beam pulses from the LAMPF linear accelerator into short bunches well matched to requirements of a high-resolution neutron-scattering materials science program. The initial performance goal for this program is to provide 100-μA average current at the neutron production target within a 12-Hz pulse rate. Project construction began in May 1982, and was completed in mid-April 1985. First beam was circulated in the ring on April 26. Operation at 20 μA is scheduled for September 1985, with full intensity within the next year. The storage ring was originally designed to function in a second mode in which six 1-ns bunches are accumulated and separately extracted every LAMPF macropulse. Implementation of this mode, which would serve a fast-neutron nuclear-physics program, has been deferred in favor of initial concentration on the neutron-scattering program. This paper summarizes the PSR design and status. Unique machine features include high peak current, two-step charge-stripping injection, a low-impedance buncher amplifier to counter beam-loading, and a high-repetition-rate strip-line extraction kicker. 19 refs., 31 figs., 3 tabs.

32007 **Glow discharge cleaning of stainless steel accelerator beam tubes.** Hseuh, H.C.; Chou, T.S.; Christianson, C.A. (Accelerator Department, Brookhaven National Laboratory, Upton, New York 11973). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* 3: No. 3, 518-522(May 1985).

Glow discharge cleaning has been employed successfully in the CERN ISR to eliminate beam induced pressure bumps and had been adopted as a final surface treatment for the beam vacuum system of CBA. A glow discharge cleaning facility for beam tubes up to 5.5 m in length has been constructed and is in operation. To ensure efficient and thorough cleaning of the long tubes, a residual gas analyzer was used to monitor the exhaust during cleaning. Quantitative studies of the glow discharge process were performed on several tubes by using Ar or Ar/O_2 mixture (0.1 to 10 Pa) and by varying the discharge density ($<$ or $=30\ \mu A/cm^2$). The results of the studies, such as the desorption yields of H_2O, CO, and CO_2 with respect to the accumulated dosage, the depletion of O_2 in Ar/O_2 mixture, will be reported here. The effect of venting to air and CO_2, as well as plasma deposition of carbon will also be discussed.

32008 **Electron storage ring beam lifetime dependence on pressure and pumping speed.** Halama, H.J. (Brookhaven National Laboratory, Upton, New York 11973). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* 3: No. 3, 1699-1702(May 1985).

The beam loss in electron storage rings depends to a large extent on the interaction of the beam with heavier residual gas molecules such as CO, CO_2, and A due to bremsstrahlung and Coulomb scattering. The gas density inside the vacuum chamber is determined by the surface condition of the vacuum chamber, which is bombarded by photons (synchrotron radiation) generated by circulating electron beams, and by the installed pumping. During the initial commissioning severe limitations on the achievable beam current were observed due to large pressure rises. The x-ray ring was shut down for several months and its vacuum system was updated and baked out. Residual gas spectra obtained after the shut down were typical of a well baked out system, i.e., hydrogen constituted ~95% of the gas and the average pressure was in the 10^{-10} Torr range. During initial operation the composition of desorbed gases was 43% H_2, 25% CO, and 16% CO_2 and CH_4. After 3 months of beam conditioning the desorption rate dropped by a factor of 5 and the CO, CO_2, and CH_4 peaks represented smaller percentage of total desorbed gas. Beam lifetime did not, however, show a corresponding increase.

44 INSTRUMENTATION

4401 Radiation Instrumentation

REFER ALSO TO CITATION(S) 30044, 30720, 32001, 32183, 32817, 33085

32009 **(AD-A—150316/8/XAB) Shuttle flight test of an advanced gamma-ray detection system. Semi-annual technical report, 1 July-31 December 1983.** Rester, A.C. (Florida Univ., Gainesville (USA). Space Astronomy Lab.). 28 Feb 1984. 21p. NTIS, PC A02/MF A01.

In August of 1983 the Gamma-Ray Advanced Detector (GRAD) Project was assigned to the AFP-675 Program for flight on a future space-shuttle mission. In order to adapt the experiment to the requirements of AFP-675, a number of changes were made both in hardware and software. However, the necessity for such changes is more than affected by an expansion in scope of the experiment made possible by the introduction of a Payload Specialist into the operation. The principal changes to be made are in the avionics, as GRAD was originally designed for operation through ground-based telemetry. This complete redesigning of our avionics to accomodate operation by a Payload Specialist from the aft flight deck of the Orbiter allows us to take advantage of very recent findings on radiation-induced microprocessor failure in other space shuttle experiments in order to make the GRAD avionics less vulnerable to such latch-ups. Advances in bismuth germanate (BGO) scintillator technology during the year since construction of the prototype GRAD now make it possible to construct a BGO shield with a closed-ended geometry. This improvement will enhance the signal-to-noise ratio. In addition, a new type of decay-vetoed calibration probe using an alpha-rather than a beta-emitting radioactive source is being investigated.

32010 **(AECL—7684) Progress report: Health Sciences Division, 1982 January 1 to March 31.** (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Jul 1982. 109p. (PR-HS—11). NTIS (US Sales Only), PC A06/MF A01. File Number DE85701526.

Investigations of etching methods of CR-39 plastic used to detect fission fragment damage tracks has led to a preliminary chemical etching before the electrochemical etch. Leakage spectrum calculations of a D_2O-moderated ^{252}Cf source suitable for neutron dosimeter calibration have been completed. The Gaussian plume model for short range atmospheric dispersion of radionuclides is being modified to account for roughness of local terrain. A capillary effect in soils, just above a watertable has been shown to be a possible mechanism whereby large hydraulic head changes and later large groundwater fluxes can be induced by relatively small additions of water. Studies of radiation damage to human DNA continue, and include also DNA damage caused by other chemical and physical factors, such as hyperthermia treatment; and the ability of human white blood cells to damage mouse cell DNA. A paper describing dose conversion factors used in the Canadian waste disposal assessment was prepared. Equipment measuring parameters of metal ion-amino acid reactions is now working, and computer programs to analyze results are being installed. A literature review report on this topic is in the final preparation stages. A computer record-keeping system for individual monitoring results is being developed.

32011 **(AECL—7777) Progress report: Health Sciences Division, 1982 April 1-June 30.** (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Aug 1982. 95p. (PR-HS—12). NTIS (US Sales Only), PC A05/MF A01. File Number DE85701527.

Chemical and electrochemical etching parameters for CR-39 plastic are being studied as a function of neutron energy from 0.2 to 14.7 MeV. An improved oven for UV annealing of sensitized TLDs has been built and optimum operating characteristics are being determined. Circuits and components for the reactor stack effluent monitor are being designed. New sensors and data loggers have been installed to measure water and air temperatures, and air velocity profiles, at Perch and Maskinonge Lakes. Measurements of ^{222}Rn and tritium have been investigated in groundwater discharge from borehole CR22, near Chalk Lake. Measurements of sorption/desorption of ^{60}Co with sediments from East Swamp have been continued. Elution rates of Pu and Am from columns and associations with particulates have been shown to depend strongly on the redox conditions. In rock fracture filling materials studies the ratios of uranium isotopes ($^{234}U/^{238}U$) and of thorium to uranium ($^{230}Th/^{238}U$) together with uranium contents are providing some values, but interpretation remains difficult. Growth rate of bivalve mollusc cultures has been shown to be affected by nutrients to different extents at the control (10 degC) and elevated (20 degC) temperatures. DNA studies of radiation effects continue. A thoron (^{220}Rn)-in-breath monitor has been designed and will be constructed at CRNL. The dose to basal cells of bronchial epithelium from inhalation of long-lived alpha-emitting aerosols has been calculated, and the risk of bronchial cancer from this dose estimated.

32012 **(AECL—8105) Progress report: Health Sciences Division, 1983 January 1-June 30.** (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Sep 1983. 131p. (PR-HS—15). NTIS (US Sales Only), PC A07/MF A01. File Number DE85701530.

Electrochemically-etched CR-39 plastic can register protons up to 7 MeV by adjusting pre-etch times. Improving TLD reader sensitivity by using a UV-transmitting light guide has been investigated for both LiF and MgB_4O_7:Dy dosimeters. A portable tritium-in-air monitor has been modified to provide compensation against response to noble gases in sampled air. Development of the stack effluent monitor continued with an examination of the relative advantages of sliding shuttles for a sample changer. Relationships between dosimeter reading and critical organ doses and effective dose equivalent have been established by tests with a phantom loaded with dosimeters and exposed in two locations. The relationship of the energy budget of Perch Lake to large scale weather patterns of the area is being investigated in a study with the University of Waterloo. The response of drainage systems to melting, infiltration and/or runoff of winter snowpack is being studied. The integrated mass of ^{137}Cs in eight lake sediments near CRNL has been found to be much less than total atmospheric fallout between 1955 and 1982. Studies have continued on freshwater molluscs in removing particulates from suspension and sedimenting the material as faecal waste. Distribution measurements of residual bomb tritium in drainage waters from the Gloucester special disposal site have been done to establish a time scale for groundwater movement. Slightly elevated levels of organically-bound ^{3}H and ^{14}C were measured in grasses near B and C Waste Management burial trenches. A customer manual describing CRNL's capability to do accurate gas or liquid system pipeline flow measurements using short half-life radiotracers is being prepared. Research continues on non-lethal radiation doses to DNA in a variety of organisms. Experimental protocol for experiments involving radioisotope administration to volunteers have been reviewed and approved.

32013 (AERE-M—3399) Construction and calibration of a simple scintillation counter for monitoring radioactive gases in ducts. Johnston, M.S. (UKAEA Atomic Energy Research Establishment, Harwell. Environmental and Medical Sciences Div.). Jul 1984. 13p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85701250.

A report is given of the practical construction, laboratory calibration and simple-in-situ calibration check of scintillation detectors used for monitoring radioactive inert gases in gaseous effluents. The $\beta\gamma$-ray and γ-ray detectors are identical except for an absorber which is placed over the window of the γ-ray detector after calibration. The construction and calibration of both detectors is therefore identical.

32014 (AERE-M—3433) Filter paper counting system incorporating a segmented alpha particle detector. Hutchinson, I.G.; Green, B.D. (UKAEA Atomic Energy Research Establishment, Harwell. Instrumentation and Applied Physics Div.). Nov 1984. 14p. HMSO, London, price Pound 4.00.

Measurements of the level of alpha-active airborne particulates are performed routinely throughout the Authority. Using appropriate sampling devices, air is drawn through filter papers in order to extract airborne particulates. The activity on these filter papers may then be counted either in situ using appropriate instruments, e.g. the alpha-in-air monitor type 3280, or alternatively off line using an alpha drawer unit such as the 0744 fitted with a solid state alpha detector. A sample with an abnormally high count may then be examined further by autoradiography to determine whether the activity is distributed homogeneously across the filter or is present as discrete particulates. In an attempt to simplify the examination, a demonstration segmented alpha detector system has been developed which will provide information about the spatial distribution of activity across the surface of filter papers. A software package to simplify data acquisition and presentation has been written for a system based on a Commodore PET and Harwell 6000 series electronics.

32015 (AERE-R—11397) Measurement of neutron spectra with hydrogen proportional counters. Part 1. Spectrometry system and calibration. Birch, R.; Peaple, L.H.J.; Delefield, H.J. (UKAEA Atomic Energy Research Establishment, Harwell. Environmental and Medical Sciences Div.). Oct 1984. 31p. HMSO, London, price Pound 5.00.

A transportable neutron spectrometry system, based on four spherical hydrogen proportional counters, has been developed to measure standard reference radiation fields, for research and development on new dosimeters, and to determine spectra in environments of moderate dose-equivalent rates. The system has been calibrated and tested using monoenergetic neutron beams of known energies, and the response functions for the four counters determined. Measurements of the spectrum of an Am-Li(α,n) source are reported. This neutron source, which produces neutrons with a mean energy of about 0.5 MeV, is of particular interest as it has potential as a standard reference source for the calibration of radiological protection instruments and dosimeters. The system has also been successfully used for measurements around a nuclear reactor although, because of its low sensitivity, the measurement times are rather long and a more sensitive system based on larger cylindrical counters is being developed specifically for this type of application.

32016 (CERN-EP—83-136) Electromagnetic calorimetry using scintillating plastic fibres. Burmeister, H.; Sonderegger, P.; Gago, J.M.; Maio, A.; Pimenta, M.; Perrin, D.; Thevenin, J.C. (European Organization for Nuclear Research, Geneva (Switzerland); Instituto Nacional de Investigacao Cientifica, Lisbon (Portugal); Neuchatel Univ. (Switzerland); CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). 9 Sep 1983. 12p. (CONF-8306110—7). NTIS (US Sales Only), PC A02/MF A01. File Number DE85901031.

From 2. Pisa meeting on advanced detectors; Castiglione della Pescaia, Italy (2 Jun 1983).

When used in lead-scintillator sandwich calorimetry, scintillating optical fibers offer a new way to achieve fine grain sampling and hereby to improve the energy and spatial resolution of a technique still unbeaten for timing and compactness. A small calorimeter element made of planes of 0.9 mm diameter fibers alternating with Pb plates has been built and tested in an electron beam. An energy resolution of σ/sub E/$\sqrt{E} \simeq$ 9.8% and 7.8% was obtained with 1 mm and 0.5 mm Pb plates, respectively. The parameters of the fibers have been measured. Calculations done with a refined version of the EGS code reproduce these results and suggest improved Pb-fiber calorimeters rivalling with Pb glass in energy resolution.

32017 (CONF-850506—6) Digital characterization of particle tracks for microdosimetry. Turner, J.E.; Hamm, R.N.; Hurst, G.S.; Wright, H.A.; Chiles, M.M. (Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 18p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85012898.

From 9. symposium on microdosimetry; Toulouse, France (20 May 1985).

Work is in progress to develop a digital approach to microdosimetry and to construct a prototype instrument to obtain digital information about charged-particle tracks. The objective of such a device is to measure the numbers of electrons produced in various subvolumes of a chamber gas along a particle's path. This paper describes results of Monte Carlo calculations of charged-particle tracks in a cubical time-projection ionization chamber containing methane. Results are presented to show the effects of electron diffusion during charge collection. The calculations indicate that the optimum ratio of field strength and pressure is about 0.6 volts cm^{-1} torr^{-1}. Examples of proton, carbon-ion, and electron tracks are shown. 2 refs., 6 figs.

32018 (DEMO—82/13) Facility for the investigation of (n, charged particle) reactions. Vourvopoulos, G.; Kossionides, E.; Paradellis, T. (Democritos Nuclear Research Center, Athens (Greece)). Dec 1982. 3p. (CONF-820942—40). NTIS (US Sales Only), PC A02/MF A01. File Number DE85701249.

From Nuclear data for science and technology international conference; Antwerp, Belgium (6 Sep 1982).

A system comprised of a gas cell and a magnetic quadrupole triplet was developed for measuring (n, charged particle) reactions. The large (2.68 m) distance between target and detector results in appreciable reduction of the background, while the solid angle (about 15 msr) ensures measurement of small cross sections.

32019 (DEMO—83/5G) Modification of a two-level track follower to a sixteen-gray-level digitizer. Kokkinias, P.; Dris, M.; Dimitriou, N. (Democritos Nuclear Research Center, Athens (Greece)). Apr 1983. 15p. (In Greek). NTIS (US Sales Only), PC A02/MF A01. File Number DE85701510.

In this report we describe the software and hardware development afforded to a track follower system in order to increase its capabilities. Thus the two-level track follower can be used as a sixteen-gray-level digitizer. The information given by the new system consists of two position coordinates on a plane and a number which specifies the gray level at that position. The original system gave only the position coordinates and that only accross tracks.

32020 (DESY—84-120) **Performance of a lead-scintillator sandwich hodoscope with photodiode readout.** Winter, G.G.; Ahme, J.; Marks, J.; Schuetz, D.; Spitzer, H.; Westermann, H.; Greif, H.; Oberlack, H. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Dec 1984. 21p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85751635.

Submitted to Nucl. Instrum. Methods.

A matrix of nine lead-scintillator sandwich shower counters with wavelength shifter and photodiode read-out was operated in an electron beam up to 6 GeV. The yield was measured to be 18500-25000 photoelectrons/GeV depending on the shape of the modules. An energy resolution of sigma/√E = 0.105 was observed, the contribution from diode and amplifier noise being 29 MeV. The position resolution was determined as sigma approx.= 3.0 mm for 3 GeV electrons.

32021 (DOE/ER/10624—T2) **[Emulsion spectrometer experiment for B and C particles].** (Oklahoma Univ., Norman (USA)). 1981. Contract AS05-80ER10629. 91p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85007105.

An experiment is proposed which employs a hybrid emulsion spectrometer to measure lifetimes and decay properties of beauty particles and charmed particles produced by interactions of high energy hadrons. The key to the experiment is a position-sensitive silicon detector. The physics motivation of the experiment and the design of the experimental apparatus and treatment of data are discussed. (LEW)

32022 (DOE/EV/04814—T2) **Development and application of the electrochemical etching technique.** Sanders, M.E. (Georgia Inst. of Tech., Atlanta (USA). School of Mechanical Engineering). Jul 1984. Contract AS05-76EV04814. 119p. NTIS, PC A06/MF A01; GPO Dep. File Number DE85010302.

This report documents the advances achieved in the development and application of several etched damage track plastic dosimeters that can be used to measure dose-equivalent from neutrons with energies from thermal to 20 MeV. The project was initiated with the design of a rem-responding dosimeter that measured fast (> 1 MeV) neutron dose-equivalent as a function of the damage track density directly induced within the volume of polycarbonate foils amplified by electrochemical etching. Stillwagon (1978) adapted electrochemical etching of polycarbonate foils (ECEPF) to alpha dosimetry and used the technique to determine Pu-239 uptake in human bone. Su (1979) extended the usefulness of the ECEPF neutron dosimetry technique to encompass thermal neutron dose measurement. The thermal neutron dosimeter was composed of an external radiator tablet made of ^{7}LiF in contact with a polycarbonate foil and utilized the thermal neutron-induced ^{6}Li(n, α)^{3}H reaction to give a dose-equivalent response as a function of alpha track density registered in the detector foil. An intermediate (1 eV-1 MeV) neutron dosimeter was developed and has been shown to give an approximately dose-equivalent response to neutrons with energies from 1 eV to 17 MeV. The intermediate neutron dosimeter consists of ^{6}LiF-Teflon/CR-39 Polymer foil assembly which is enclosed by a (Cd + In) neutron filter. The neutron dose-equivalent is measured as a variable function of the damage track density registered in the CR-39 detector foil due to alpha particles from the 1/v dependent ^{6}Li(n, α)^{3}H reaction, recoil H, C, O nuclei from neutron-induced elastic scattering within the foil volume, and protons from the ^{6}Li(n, p) reaction for neutron energies above 2 MeV. 46 figs., 6 tabs.

32023 (EGG—10282-2054) **New and revised methods of purifying mercuric iodide.** Skinner, N.; Wedum, E.E. (EG and G, Inc., Goleta, CA (USA). Santa Barbara Operations). 1985. Contract AC08-83NV10282. 21p. (CONF-8505142—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE85011684.

From American Association of Crystal Growth workshop on purification of materials for crystal growth and glass processing; Watsonville, CA, USA (14 May 1985).

Large single crystals of mercuric iodide are grown by the vapor transport method at EG and G Energy Measurements, Inc., laboratories to provide materials for fabrication of efficient x-ray and gamma ray detectors. Commercially available high-purity mercuric iodide powder must be further purified before it can be used as starting material for the crystal growth process. The "standard" purification procedures we have developed are reviewed, and two methods used in conjunction with this procedure are described. Results are discussed in terms of impurity analyses and detector performance. Sources of mercuric iodide and experiments in progress are outlined.

32024 (IAEA-R—2907-F) **Theoretical and experimental determination of neutron sensitivity for high-pressure ionization chambers filled with CO_2. Final report for the period 1 July 1981-30 June 1984.** Zielczynski, M. (International Atomic Energy Agency, Vienna (Austria)). Sep 1984. 28p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. File Number DE85701251.

Neutron sensitivity of high pressure ionization chambers filled with CO_2 was investigated as well as optimum conditions for operations of these chambers. The ion collection efficiency was experimentally determined for gamma, alpha and neutron radiation in CO_2 at pressures ranging from 0.1 to 5.5 MPa and electrical field strengths from 1 to 3000 V/cm. It was confirmed that the Jaffe theory gives a good approximation for high LET particles at pressures above 0.2 MPa. The absorbed dose distributions versus LET in CO_2 for neutrons with energies between 0.1 and 15 MeV were calculated and a formula was developed for calculation of neutron sensitivity, the upper limit of dose rate, the energy characteristics as well as the temperature coefficient. Appropriately designed ionization chambers were then constructed and used for determination of absorbed dose components in fields from typical neutron sources, such as Cf-252 and Pu-Be. By applying appropriate electrical field strength to these ionization chambers, a 10 times reduction of the ratio of neutron-to-gamma radiation sensitivity is achievable due to ion recombination. The optimal pressure of CO_2 was found to be 3.1+-0.5 MPa, when used at temperatures between -5 deg. C and +50 deg. C. At field strengths below 100 V/cm the ratio of neutron-to-gamma sensitivity does not exceed 1% for neutron energies up to 8 MeV. The usefulness of these chambers was confirmed, especially for use in mixed radiation fields with neutrons of restricted energies but unknown energy spectra.

32025 (IPNO—83-04) **Analysis of the statistical operation of a time-numerical code multistop with a resolution of 0.5ns.** Festa, E.; Sellem, R.; Tassan-Got, L. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). 1983. 33p. (In French). NTIS (US Sales Only), PC A03/MF A01. File Number DE85751324.

This article describes a multistop TDC with a resolution of 0.5 ns and a dead time less than 40 ns. The broadening of measured distributions is analyzed and calculated for the real device having a discrepancy in channel width and working randomly with sliding scale effect.

32026 (IPNO-DRE—84-17) **π0-4π. A π^0 high solid angle detector and spectrometer.** Adam, G.S.; Blanpied, C.S.; Bovet, E. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). 1984. 66p. (In French). NTIS (US Sales Only), PC A04/MF A01. File Number DE85751322.

In this report, a new type of π^0 detector is described, the π^0 being produced in intermediate energy, nuclear reactions. The detector has been designed to give a good efficiency, to present a great angular acceptance and to be able to operate in view of an important background. The basic structure is modular and can be improved later on to reach the characteristics of a real π^0 spectrometer.

32027 (KFK—3858) Upgrading the CELLO track detector. Fluegge, G. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Kernphysik). Jan 1985. 22p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85751627.

The CELLO detector and its central tracking detector in particular are described. Improvements and limitations of the detector performance are discussed. A new design optimized for good pattern recognition and momentum and vertex resolution at highest PETRA energies is presented. It consists of a large pressurized all stereo wire chamber (SWC). The hexagonal cells are densely packed in two stereo views at +-2°. A vertex chamber with a thin Be beampipe is an integral part of the drift chamber. Pattern recognition properties and chamber resolutions are discussed. A momentum resolution of 0.5%xp (GeV/c) and a vertex resolution of 120 μm are expected.

32028 (KFKI—1984-81) Thermoluminescent dose measurements on board Salyut type orbital stations. Akatov, Yu.A.; Arkhangelskij, V.V.; Aleksandrov, A.P. (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). Jun 1984. 8p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85701248.

A small, vibration- and shock-resistant thermoluminescent dosemeter (TLD) system - named PILLE - was developed for orbital stations at the Central Research Institute for Physics, Hungary, to measure the cosmic radiation dose on-board. The first onboard measurements with this system were performed by B. Farkas, the Hungarian astronaut, on the Salyut-6 space station in 1980. The same instrument was used by other crews in the following years. Doses measured at different sites in Salyut-6 are presented. The dose rates varied from 0.7 to 0.11 mGy.day^{-1}. After the first cosmic measurements, the system was further developed. The minimum detectable dose of the new TLD system is 1 μGy, i.e. less by one order of magnitude than that of the former system. The self-irradiation dose rate of the TLD bulbs is also reduced by more than an order of magnitude to 10 nGy.h^{-1}, by use of potassium-free glass for the bulb envelope. This new type of PILLE TLD system is currently on-board Salyut-7. The dose rates (0.12-0.23 mGy.day^{-1}) measured in 1983 are presented in detail.

32029 (LA-UR—85-1476) Observations on ^{3}He neutron spectrometry. Evans, A.E. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 5p. (CONF-850507—3). NTIS, PC A02/MF A01; GPO Dep. File Number DE85010731.

From International conference on nuclear data for basic and applied science; Santa Fe, NM, USA (13 May 1985).

The energy resolution of a ^{3}He ionization chamber, which varies from 13 keV FWHM at 0 keV to approximately 30 keV at 1 MeV, allows abservation of false peaks due to the presence of scattering or absorbing materials and due to accidental near-coincidences of the rather long-risetime detector pulses. Pulse-risetime distributions depend on the neutron beam's angle of incidence to the detector axis; ability to separate ^{3}He-recoil pulses from full-energy ^{3}He(n,p) pulses diminishes for neutrons of energy greater than 1.5 MeV and incident normal to the detector axis. When high-energy neutrons are present, measurement at a grazing angle is recommended.

32030 (MPI-PAE/Exp.El.—142) Silicon strip detectors with capacitative charge division. Koetz, U.; Poesnecker, K.U.; Gatti, E.; Kemmer, J.; Belau, E.; Buchholz, D.; Hofmann, R.; Klanner, R.; Lutz, G.; Neugebauer, E. (Max-Planck-Institut fuer Physik und Astrophysik, Muenchen (Germany, F.R.). Werner-Heisenberg-Inst. fuer Physik). Nov 1984. 22p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85751136.

Measurements of the behaviour of various high-resolution silicon strip detectors with capacitative charge division have been made in a high-energy particle beam. The results are compared with an electrostatic model which calculates the charges deposited on the strips after the passage of a minimum ionizing particle. Good agreement is found and the model is used to propose a method of improving the charge-division properties of such detectors.

32031 (NAC-AR—84-01, pp 174-175) Report of the Van de Graaff Group: nuclear reactions and nuclear structure. Response of thin film plastic scintillators to fission fragments. Cilliers, W.A.; Brooks, F.D. (Cape Town Univ. (South Africa)); Allie, M.S. 1984. NTIS (US Sales Only), PC A14/MF A01. File Number DE85780939.

Short note.

In Annual report June 1984. [Council for Scientific and Industrial Research, Faure (South Africa). National Accelerator Center].

32032 (NRCN(TN)—077) New thermal neutron solid-state electronic detector based on HgI_2 crystals. Melamud, M.; Burshtein, Z. (Israel Atomic Energy Commission, Beer-sheba. Nuclear Research Center-Negev). Jul 1983. 29p. (In Hebrew). NTIS (US Sales Only), PC A03/MF A01. File Number DE85701509.

We describe the development of a new solid-state electronic neutron detector, based on HgI_2 single crystals. Incident neutrons are absorbed in high neutron absorbing foils, such as cadmium or gadolinium, which are placed in front of a HgI_2 detector. Gamma rays, emitted as a result of the neutron absorbtion, are then absorbed in the HgI_2, generating free charge carriers, which are collected by the electric field. The advantage of this system lies in it's manufacturing simplicity, low weight and small physical dimensions, compared to gas-filled conventional neutron detectors. The disadvantage is that the system does not discriminate between gamma rays and neutrons. A method to minimize this disadvantage is pointed out. It is as well possible to count neutrons by direct exposure of the HgI_2 to neutrons. The neutron-to-gamma transformation in that case takes place by the material nuclei themselves. This method, however, is impractical due to the interference of delayed radioactivity whose origin are ^{129}I nuclei. They are generated from ^{128}I by absorbing a neutron, and decay with a 25 min half lifetime involving gamma emissions.

32033 (PNL-SA—12901) Beta response of selected instruments. Swinth, K.L.; Rathbun, L.A.; Hooker, C.D.; Roberson, P.L.; Kenoyer, J.L. (Pacific Northwest Labs., Richland, WA (USA)). May 1985. Contract AC06-76RL01830. 11p. (CONF-8505103—4). NTIS, PC A02/MF A01; GPO Dep. File Number DE85013278.

From Health Physics Society annual meeting; Chicago, IL, USA (26 May 1985).

The Beta Measurement Evaluation and Upgrade Program managed by Pacific Northwest Laboratory (PNL) for the Department of Energy's (DOE) Office of Nuclear Safety is focusing upon the identification and resolution of problems associated with the measurement of beta dose at DOE facilities. As part of this project, commonly used instruments and instruments under development are being evaluated with regard to their beta response and general performance characteristics. The purpose of this paper is to describe test results for accuracy, beta energy response, angular response and general performance characteristics for selected instruments.

32034 (TRW-SN—39146) Investigation of non-intrusive radiometers for entrained gasifier temperature measurement. Fourth quarterly report, August 1-October 31, 1984. Revision 3. Gat, N. (TRW, Inc., Redondo Beach, CA (USA). Applied Technology Div.). 11 Mar 1985. Contract AC21-83MC20468. 14p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85011795.

The objective of this project is to develop and test a nonintrusive radiometer for entrained bed gasifier/combustor temperature measurements. This quarterly report is focused on design, fabrication and testing of radiometers. 3 refs., 5 figs., 1 tab.

32035 **Mark III spectrometer.** Bernstein, D.; Bernstein, J.; Bunnell, K.; Burgueno, G.; Cassell, R.; Collins, B.; Coward, D.; Einsweiler, K.; Eisele, R.; Haber, B. (Stanford Linear Accelerator Center, CA (USA)). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **226**: No. 2/3, 301-318(Oct 1984).

This paper describes the design, construction and performance of the Mark III, a new general purpose large solid angle spectrometer at SPEAR, the SLAC 2-8 GeV e^+e^- storage ring. The detector has been designed for the study of exclusive final states in e^+e^- annihilation, which requires large solid angle coverage combined with charged particle momentum resolution, particle identification, and photon detection efficiency at low energies.

32036 **Low-noise amplifier for resolving the right-left ambiguity in drift chambers.** Brown, D. (Los Alamos National Lab., NM (USA)). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **226**: No. 2/3, 405-410(Oct 1984).

A low-noise amplifier has been developed for resolving the right-left ambiguity of particle position in delay-line readout drift chambers (DLRDCs). The amplifier provides signals that are proportional to both the sum and difference of two sets of cathode sense wires in a DLRDC. Amplifier risetime is approx.= 18 ns and the input noise is approx.= 6 μVsub(rms). Amplifier design and performance are described.

32037 **Monte Carlo calculation of the average solid angle subtended by a parallelepiped detector from a distributed source.** Wielopolski, L. (Brookhaven National Lab., Upton, NY (USA). Medical Research Center). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **226**: No. 2/3, 436-448(Oct 1984).

A Monte Carlo method utilizing total variance reduction is applied to the calculation of the solid angle subtended by a parallelepiped detector from an arbitrarily positioned point. Although there is an analytical expression for the solid angle subtended by a rectangle from an arbitrary point, the method should prove valuable when a mean solid angle from a distributed source is required. In addition, the algorithm provides an efficient way to sample the directions of gamma rays which intercept a parallelepiped detector, required in the Monte Carlo calculations of the efficiency of square detectors.

32038 **Central drift chamber for the Mark III detector at SPEAR.** Roehrig, J.; Einsweiler, K.; Hutchinson, D.; McNerney, E.; Odian, A.; Skarpaas, K.; Unno, Y.; Villa, F. (Stanford Linear Accelerator Center, CA (USA)); Grancagnolo, F.; Rowe, W. *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **226**: No. 2/3, 319-329(Oct 1984).

A large cylindrical drift chamber has been constructed for the MARK III detector at SPEAR. The inner layer has a high density of sense wires for the measurement of kinks, vees, and dE/dx. The outer layers have a cell design with three sense wires, giving uniform drift behavior and left/right ambiguity resolution within a cell. The chamber has both current division and stereo layers for longitudinal position measurement.

32039 **Series-parallel gradiometers for monopole detectors.** Somalwar, S.; Frisch, H.; Incandela, J. (Chicago Univ., IL (USA). Enrico Fermi Inst.; Chicago Univ., IL (USA). Dept. of Physics); Kuchnir, M. (Fermi National Accelerator Lab., Batavia, IL (USA)). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **226**: No. 2/3, 341-343(Oct 1984).

We outline a new scheme for designing large planar gradiometers used in monopole searches by induction. With this scheme, the signal falls as $1/\sqrt{L}$ rather than as $1/L$, where L is the inductance of the detector loop. The signal coupling in this scheme is better than is achievable in practice with conventional matching transformers. Also, segmentation facilitates the manufacture of bigger gradiometers. Results from prototype tests are reported and agree with calculation.

32040 **Silicon detectors: New challenges.** Walton, J.T. (Lawrence Berkeley Lab., CA (USA)). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **226**: No. 1, 1-11(15 Sep 1984). (CONF-8311154—). Contract AC03-76SF00098.

From 3. European symposium on semiconductor detectors; Munich, F.R. Germany (14 Nov 1983).

An introduction is given to the areas of current interest in silicon radiation detector design and fabrication. Problems associated with detector grade silicon are reviewed. Passivation of detector surfaces with silicon dioxide or amorphous silicon is described. Two examples of silicon detector application in X-ray detection and X-ray angiography are presented.

32041 **Silicon drift chambers - first results and optimum processing of signals.** Gatti, E. (Politecnico di Milano (Italy). Ist. di Elettronica); Rehak, P. (Brookhaven National Lab., Upton, NY (USA)); Walton, J.T. (Lawrence Berkeley Lab., CA (USA)). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **226**: No. 1, 129-141(15 Sep 1984). (CONF-8311154—). Contract AC02-76CH00016.

From 3. European symposium on semiconductor detectors; Munich, F.R. Germany (14 Nov 1983).

A Semiconductor Drift Chamber was produced and tested. The paper describes: 1) principle of the chamber operation; 2) the performance of the test chamber; 3) the signal processing to obtain the best position resolution.

32042 **Semiconductor position-sensitive detectors.** Radeka, V. (Brookhaven National Lab., Upton, NY (USA)). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **226**: No. 1, 209-218(15 Sep 1984). (CONF-8311154—). Contract AC02-76CH00016.

From 3. European symposium on semiconductor detectors; Munich, F.R. Germany (14 Nov 1983).

Basic concepts for position sensing in particle and photon semiconductor detectors are summarized. Signal and noise criteria are discussed, particularly in view of the trends toward monolithic integration of charge sensing and position readout circuits with the detector.

32043 **Development of high density readout for silicon strip detectors.** Walker, J.T. (Stanford Univ., CA (USA)); Parker, S. (Hawaii Univ., Honolulu (USA)); Hyams, B. (European Organization for Nuclear Research, Geneva (Switzerland)); Shapiro, S.L. (Stanford Linear Accelerator Center, CA (USA)). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **226**: No. 1, 200-203(15 Sep 1984). (CONF-8311154—).

From 3. European symposium on semiconductor detectors; Munich, F.R. Germany (14 Nov 1983).

A compact readout for silicon strip detectors is being developed. It employs an nMOS circuit with 128 channels of charge sensitive amplifiers and multiplexed output.

32044 **Update on the TPC at TRIUMF.** Mes, H.; Dixit, M.S.; Hargrove, C.K. (National Research Council of Canada, Ottawa, Ontario. Div. of Physics); Anderson, H.L.; McKee, R.J. (Los Alamos National Lab., NM (USA)); Azuelos, G.; Depommier, P.; Martin, J.P.; Poutissou, R. (Montreal Univ., Quebec (Canada)); Blecher, M. *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **225**: No. 3, 547-549(1 Sep 1984). (CONF-8306110—).

From 2. Pisa meeting on advanced detectors; Castiglione della Pescaia, Italy (2 Jun 1983).

Several improvements have recently been made to the TRIUMF TPC. These include the addition of a grid system, corrections to the electrostatic field cage and a sequential gate generator. Our experience with this new TPC will be discussed.

32045 **Search for the best timing strategy in high precision drift chambers.** Va'vra, J. (Stanford Linear Accelerator Center, CA (USA)). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **225**: No. 3, 445-453(1 Sep 1984). (CONF-8306110—). Contract AC03-76SF00515.

From 2. Pisa meeting on advanced detectors; Castiglione della Pescaia, Italy (2 Jun 1983).

Computer simulated drift chamber pulses are used to investigate various possible timing strategies in drift chambers. In particular, leading edge, multiple threshold and flash ADC timing methods are compared. Although the presented method is general for any drift geometry, we concentrate our discussion on jet chambers where the drift velocity is about 3-5 cm/μs and the individual ionization clusters are not resolved, due to a finite speed of our electronics. We will not discuss the geometries where the drift time is expanded further and the individual clusters can be recorded (this is covered by a talk by Walenta).

32046 **Semiconductor drift chamber - an application of a novel charge transport scheme.** Gatti, E.; Rehak, P. (Brookhaven National Lab., Upton, NY (USA)). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **225**: No. 3, 608-614(1 Sep 1984). (CONF-8306110—).

From 2. Pisa meeting on advanced detectors; Castiglione della Pescaia, Italy (2 Jun 1983).

The purpose of this paper is to describe a novel charge transport scheme in semiconductors, in which the field responsible for the charge transport is independent of the depletion field. The application of the novel charge transport scheme leads to the following new semiconductor detectors: 1) Semiconductor drift chamber; 2) Ultralow capacitance - large area semiconductor X-ray spectrometers and photodiodes; 3) Fully depleted thick CCD. Special attention is paid to the concept of the semiconductor drift chamber as a position sensing detector for high energy charged particles. Position resolution limiting factors are considered and the values of the resolutions are given.

32047 **Lorentz factors for large-mosaic crystals.** Axe, J.D.; Hastings, J.B. (Brookhaven National Lab., Upton, NY). *Acta Crystallographica, Section A: Foundations of Crystallography;* **A39**: 593-594(1983).

General expressions are derived for the Lorentz factor for two- and three-axis spectrometers to be used when the vertical resolution is comparable to or less than the mosaic of the measured Bragg reflections. 3 references, 1 figure.

4402 Radiation Effects On Instrument Components, Instruments, Or Electronic Systems

REFER ALSO TO CITATION(S) 30687

32048 **(AERE-R—10715) Selection of radiation tolerant electrical/electronic components for gamma radiation environments in the nuclear power industry.** Garlick, D.R. (UKAEA Atomic Energy Research Establishment, Harwell. Engineering Projects Div.). Sep 1984. 91p. NTIS (US Sales Only), PC A05/MF A01. File Number DE85701512.

This report briefly describes the mechanisms, units and effects of 1 MeV range gamma radiation on electrical/electronic components and materials. Information is tabulated on the gamma radiation tolerance of a wide range of components and materials. A radiation testing service, based at Harwell, is described. Lists of interested manufacturers and organisations are given.

32049 **(HMI-B—353-Vol.3-Ed.2) GfW-handbook for data compilation of irradiation tested electronic components. Vol. 3.** Wulf, F.; Braeunig, D.; Boden, A. (Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (Germany, F.R.). Bereich Datenverarbeitung und Elektronik; Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e.V., Koeln (Germany, F.R.). Bereich fuer Projekttraegerschaften). May 1984. 664p. NTIS (US Sales Only), PC A99/MF A01. File Number DE85780967.

Loose-leaf collection.

The 2nd edition is a continuation of the 1st edition and is published as a loose-leaf handbook. The 1st edition contained 190 test reports. In the volume 1 and volume 2 of the 2nd edition 120 test reports have been published so far. The present volume 3 of the 2nd edition provides further 53 test reports. These test reports of currently in space projects used electronic components have a standardized format. The results are given in a comprehensive but easily to handle graphical and tabular presentation. Statistical values are given in order to facilitate the components life time evaluation in a radiative environment.

32050 **Radiation damage in silicon detectors.** Kraner, H.W. (Brookhaven National Lab., Upton, NY (USA)). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **225**: No. 3, 615-618(1 Sep 1984). (CONF-8306110—). Contract AC02-76CH00016.

From 2. Pisa meeting on advanced detectors; Castiglione della Pescaia, Italy (2 Jun 1983).

A review is presented of the effects of radiation damage on silicon detectors, which are being considered for high energy physics applications. The main degradation in performance is an increase in leakage current, which can be well characterized by an empirical damage constant for many radiations. A summary of data on damage constants is given. A brief discussion of annealing effects in terms of band gap level changes is included.

4403 Miscellaneous Instruments

REFER ALSO TO CITATION(S) 31225, 31496, 31823, 32435

32051 **(EPRI-EL—3984) Underground obstacle detection and mapping system. Final report.** Caldecott, R.; Young, J.D.; Hall, J.P.; Terzuoli, A.J. (Ohio State Univ., Columbus (USA). Electroscience Lab.). May 1985. 258p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920662.

Unless the locations of existing pipe or other underground objects are known, installing or repairing utility systems under city streets can disrupt service and entail risk for work crews. Groundscan, a computerized, radar-based mapping system, scans construction corridors to map the depth and horizontal layout of underground objects.

32052 **(IS-T—1174) Continuum flow sampling mass spectrometer for elemental analysis with an inductively coupled plasma ion source.** Olivares, J.A. (Ames Lab., IA (USA)). Jun 1985. Contract W-7405-ENG-82. 113p. NTIS, PC A06/MF A01; GPO Dep. File Number DE85012255.

Thesis.

The sampling of ions from an atmospheric pressure inductively coupled plasma for mass spectrometry (ICP-MS) with a supersonic nozzle and skimmer is shown to follow similar behavior found for neutral beam studies and for ion extraction from other plasmas and flames. In particular, highest ion beam intensity is found if the skimmer tip is close to the Mach disk and at a calculated skimming Knudsen number close to the recommended value of 1. Our ICP-MS instrument with an off-axis detector and conventional cylindrical electrostatic ion focusing in the transition flow regime gives intense count rates of 1 to 5 MHz per mg L^{-1} of analyte superimposed on a background of 1 to 10 kHz. The dependence of count rates for metal oxide and doubly charged ions on ICP operating parameters, and sampling interface configuration are discussed for this instrument. A simple method is described for the approximate measurement of the ion energy distribution in ICP-

MS. The average ion kinetic energy, kinetic energy spread, and maximum kinetic energy are evaluated from a plot of ion signal as a function of retarding voltage applied to the quadrupole mass analyzer. The effects of plasma operating parameters on ion signals and energies are described. In particular, kinetic energy is a sensitive function of aerosol gas flow rate. This behavior is attributed to a non-thermal, possibly electrical, interaction between the plasma and the sampling interface, which is induced by the presence of the axial channel in the ICP. The interference on the ionization of cobalt by five salts, NaCl, $MgCl_2$, NH_4I, NH_4Br and NH_4Cl, in an ICP is first considered theoretically and subsequently the theoretical trends are established experimentally by ICP-MS. The interference trends are found to be in the order of the most easily ionized element in the matrix salt, i.e., Na > Mg > I > Br > Cl.

32053 (JINR—11-83-531) **Universal control drive unit using micro-computer and its application in the SPN-1 spectrometer.** Bilkenrot, R.; Rodik, Kh.; Shvenkner, V.; Mikhaehlis, B. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1983. 4p. (In Russian). (CONF-8309239—3). NTIS (US Sales Only), PC A02/MF A01. File Number DE85701247.

From 11. international symposium on nuclear electronics; Bratislava, Czechoslovakia (13 Sep 1983).

A control drive unit based on the K 1520 micro-computer is described. It is capable of controlling 16 servomotors, max., and process data from the corresponding transducers. Three servomotors can be controlled at the same time either from the control desk or the controlling computer of an experiment. The software developed for the unit is meant for operating both from the control desk and computer, for processing data from transducers, controlling the position, checking the maximum permissible quantities and correctness of setting operations, some other functions are realized as well.

32054 (KFK—3843) **Test of an optical fibre-laser-photometer with samples of the facility PUTE.** Groll, P.; Persohn, M.; Roemer, J.; Schuler, B. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Heisse Chemie; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Wiederaufarbeitung und Abfallbehandlung). Nov 1984. 32p. (In German). (PWA—81/84). NTIS (US Sales Only), PC A03/MF A01. File Number DE85751140.

The test of a photometer with a dye-laser as light-source is described. The light circuit between laser, optical cell and photodiods uses optical fibre. The concentration of nitric acid has been analyzed by conductivity measurements. Pu-samples of the testing facility PUTE have been analyzed for their concentration of U^{4+}, U^{6+}, Pu^{3+}, Pu^{4+} and free nitric acid. In parallel the same samples have been analyzed by a grating-photometer. The concentration of total uranium and plutonium has been determined by x-ray-fluorescence. The concentration of free acid was analyzed acidimetric. The results of the three methods show excellent agreement for the concentration of plutonium and acid. The deviation is less than 5 g/l. The results of the analysis of uranium deviates more. The results are discussed in detail. 53 figures.

32055 (KFK—3844) **Optical-fiber-laser-photometer for In line measurements in the purex process.** Roemer, J.; Groll, P.; Persohn, M.; Schuler, B. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Heisse Chemie; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Wiederaufarbeitung und Abfallbehandlung). Nov 1984. 42p. (In German). (PWA—82/84). NTIS (US Sales Only), PC A04/MF A01. File Number DE85751141.

An optical-fiber-laser-photometer has been developed. It was thoroughly tested with all components. The used N_2-laser and dyes of the dye laser are very well suited for continuous working. The transmission of the optical fiber is very high in the used wavelength region and decreases to 5 db/m by a radioactive dose of 5 Mrad. The distance between the laser and the measuring cell can be up to 100 m. The reproducibility of the measured transmission without any sample is better then 0.2% without any trend. The analytical results of U-IV- and U-VI-solutions have only a small systematic deviation of 2.0% compared with a non-optical method. The measurements of Pu-III-, Pu-IV- and Pu-III/Pu-IV-solutions are performed in a glove box. They are in good accordance with a titrimetric method. 20 figures.

32056 (LA-UR—84-3578) **Proposed method for remote thermometry in turbine engines.** Noel, B.W.; Cates, M.R.; Allison, S.W.; Borella, H.M.; Franks, L.A.; Marshall, B.R. (Los Alamos National Lab., NM (USA); Oak Ridge Gaseous Diffusion Plant, TN (USA); EG and G, Inc., Goleta, CA (USA)). 1985. Contract W-7405-ENG-36. 7p. (CONF-850712—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE85003755.

From 21. AIAA/ASME/SAE joint propulsion conference; Monterey, CA, USA (8 Jul 1985).

The method uses laser-induced fluorescence from a pulsed uv laser to excite a rare-earth-oxide phosphor bonded in a thin layer to the surface to be measured. The luminescent decay times of certain lines are temperature-dependent. Initial results indicate that at least one phosphor, europium-doped yttrium oxide, is usable to 950°C. (DLC)

32057 (LBL—19319) **Applications of holography to x-ray imaging.** Howells, M.; Iarocci, M.; Kenney, J.; Rarback, H.; Rosser, R.; Yun, W. (State Univ. of New York, Stony Brook (USA). Dept. of Physics; Brookhaven National Lab., Upton, NY (USA); Lawrence Berkeley Lab., CA (USA)). Mar 1985. Contract AC02-76CH00016;AC03-76SF00098. 10p. (CONF-850137—3). NTIS, PC A02/MF A01; GPO Dep. File Number DE85010984.

From International Society for Optical Engineering meeting; Los Angeles, CA, USA (21 Jan 1985).

In this paper we consider various applications of holographic techniques to the problem of soft x-ray imaging. We give special attention to imaging biological material using x-rays in the wavelength range 24 to 45A. We describe some experiments on formation and reconstruction of x-ray holograms and propose some ways in which holographic techniques might contribute to the difficult problem of fabricating optical elements for use in the soft x-ray region.

32058 (LMF—113, pp 39-44) **Performance of a single-stage virtual impactor.** Chen, B.T.; Yeh, H.C.; Cheng, Y.S. Dec 1984. NTIS, PC A23/MF A01. File Number DE85009283.

In Inhalation Toxicology Research Institute annual report, October 1, 1983-September 30, 1984.

Aerosol separation characteristics of a single-stage virtual impactor are described. Data indicate that the efficiency curve and the 50% cutoff Stokes number (cutoff size) are insensitive to variations in the nozzle Reynolds number (Re), and can be predicted as long as the corresponding Re is between 1000 and 8000, the ratio of nozzle-to-probe distance to the nozzle diameter (W) is about 1, and the ratio of the hole diameter to W is between 1.2 and 1.5. The results show that the cutoff sizes are affected by the ratio of minor flow rate to the total flow rate. In addition, it was found that there were substantial deposition losses (20 - 40%) on the surface of the collection probe for particles with aerodynamic diameters near the cutoff size. 3 references, 4 figures, 2 tables.

32059 (NAC-AR—84-01, pp 191) **Report of the Van de Graaff Group: nuclear analysis. Standardisation of PIXE equipment.** Peisach, M.; Pineda, C.A. (Cape Provincial Administration). 1984. NTIS (US Sales Only), PC A14/MF A01. File Number DE85780939.

Short note.

In Annual report June 1984. [Council for Scientific and Industrial Research, Faure (South Africa). National Accelerator Centre].

32060 (NAC-AR—84-01, pp 191) **Report of the Van de Graaff Group: nuclear analysis. Construction of XSQR irradiation chamber.** Peisach, M.; Pineda, C.A. (Cape Provincial Administration); Swart, T. 1984. NTIS (US Sales Only), PC A14/MF A01. File Number DE85780939.

Short note.

In Annual report June 1984. [Council for Scientific and Industrial Research, Faure (South Africa). National Accelerator Centre].

32061 (OEFZS—4306) ELBEST x-ray fluorescence measuring system for on-stream analysis in flotation plants. Donhoffer, D. (Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H. Inst. fuer Isotopenanwendung). Jan 1985. 5p. (In German). (IA—134/85). NTIS (US Sales Only), PC A02/MF A01. File Number DE85701481.

The ELBEST measuring system was developed for continuous onstream measurement of mineral slurries in ore processing plants. The system, which is based on isotope-excited energy dispersive X-ray-fluorescence is described. An application for measurement of Pb/Zn ores in a flotation plant for these ores is given.

32062 (PNL-SA—12863) ELCAP instrumentation. Schuster, G.J.; Tomich, S.D. (Pacific Northwest Labs., Richland, WA (USA)). Apr 1985. Contract AC06-76RL01830;AC79-83BP13795. 7p. (CONF-850175—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE85013042.

From EPRI end-use metering workshop; Seattle, WA, USA (15 Jan 1985).

Over the past few years Pacific Northwest Laboratory has developed a series of data loggers. The most recently completed logger, designed to meet these requirements, is currently being deployed in the End-Use Load and Conservation Assessment Program (ELCAP), an end-use metering study of 1000 residential and commercial structures in BPA's service territory. This document provides a functional description of the data logger, describing both the main hardware components and the system's software. Application of the logger to power measurements and meteorological and interior condition measurements is discussed along with experience on field performance. A table is provided showing approximate data logger, sensor, and installation costs as experienced in this study.

32063 (SAND—84-2544C) Calibrated Faraday current and magnetic field sensor. Neyer, B.T.; Chang, J.; Lockwood, G.J.; Ruggles, L.E. (Sandia National Labs., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 10p. (CONF-850616—38). NTIS, PC A02/MF A01; GPO Dep. File Number DE85013438.

From 5. IEEE pulsed power conference; Washington, DC, USA (10 Jun 1985).

We have developed a calibrated optical fiber Faraday rotation current sensor. This sensor has a gigahertz response, is immune to electromagnetic interference, and is constructed entirely of dielectric material. All of these advantages make the sensor ideal for pulsed power measurements.

32064 (SAND—85-0548) Calibrator for displacement gages used in the rock mechanics laboratory. McNamee, M.J. (Sandia National Labs., Albuquerque, NM (USA)). May 1985. Contract AC04-76DP00789. 24p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85013257.

A system for calibration of LVDT's (linear variable displacement transformer) has been developed for use in the rock mechanics laboratory. The new calibrator system works on an electrical-mechanical principle where a mechanical translator moves a holding fixture, which has provisions for both the calibrator measurement standard, a precision gage head LVDT and the LVDT(s) of interest during the calibration procedure. Output voltages from both the calibrator standard and the gage(s) being calibrated are easily recorded by laboratory computers, making printouts and plots of data a simple task. The new system avoids measurement errors introduced by micrometer thread backlash and spindle sticking associated with previous mechanical systems.

32065 (SAND—85-0841C) Understanding and improving acoustic to seismic coupling as it pertains to Sandia's helicopter detector. Elliott, G.; Fogler, R.J. (Sandia National Labs., Albuquerque, NM (USA)). 18 Mar 1985. Contract AC04-76DP00789. 22p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85009440.

This report covers results to date of an ongoing study undertaken in mid 1984 for the purpose of understanding the basic physics of the acoustic-to-seismic coupling phenomenon involved in the operation of a helicopter detector under development at Sandia National Laboratories. This study has been recently expanded to include assistance from the US Army Waterways Experiment Station and the University of Mississippi. A series of tests were conducted near Albuquerque, New Mexico USA, for the purpose of investigating the coupling phenomenon using an impulsive noise source and two different helicopters. Results of these tests including the evaluation of a new microphone windscreen design are reported.

32066 (UCID—20047) Sorption detector system for chemical agents detection and recognition. Olness, D.; Hirschfeld, T. (Lawrence Livermore National Lab., CA (USA)). 22 Mar 1984. Contract W-7405-ENG-48. 54p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85012775.

The use of the piezoelectric sorption sensor, in which an analyte's absorption in a thin surface layer on a piezoelectric vibrator changes its resonant frequency, has been extensively described. In every instance, the chemical selectivity of the device hinges on that of the absorbing layer. In a complex environment, a few analytes are so distinctive as to permit this. An alternative approach uses an array of crystals (or of vibrational nodes in a microlithographically cut multivibrator) covered with a number of different absorbing layers. These are so thin that they operate in the saturation mode, with different partition coefficients against air resulting in different frequency shifts for each layer. The behavior in Fourier space of these frequency shifts is then used for pattern recognition of individual chemicals. Mixture overlap can then be handled via time derivative measurements, factor analysis, or correlation spectroscopy. Experimental results from this combination of chemometrics and their "Fourier transform mechanical spectroscopy" are given. Experimental results of the demonstrated feasibility of a procedure for providing complete selectivity to quartz piezobalance sensors, by using an array of different sensor layers and pattern recognition, are presented. A laboratory test system, based on this technology, is described.

32067 Fiber-optic spectral-streak equalizer. Reedy, R.P.; Roeske F. Jr.; Smith, D.E. (Lawrence Livermore National Laboratory, University of California, P. O. Box 808, Livermore, California 94550). *Review of Scientific Instruments;* **56**: No. 7, 1356-1362(Jul 1985). Contract W-7405-ENG-48.

A spectral-streak equalizer was developed for use with an electronic streak camera to correct for material dispersion in optical fibers. Material dispersion occurs because different wavelengths of light travel at different speeds through glass fibers; the resulting difference in transit times broadens light pulses, which can lead to errors in certain scientific applications. This new instrument combines optical equalization and streak equalization techniques; it uses an array of optical fibers, as in the optical equalization technique, to partially compensate for the dispersion and uses the streak camera dynamics, as in the streak equalization technique, to complete the compensation. This paper examines the principles of equalization and compares several techniques, enumerates general and specific design considerations, outlines the calibration procedure, details efficiency estimates, describes testing techniques, gives calibration data and test results for spectral-streak equalizers currently in use, and draws conclusions from recent experience with these devices.

32068 Small mass spectrometer probe for analyzing hydrogen ion species. Leung, K.N.; Guethlein, G. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Review of Scientific Instruments;* **56**: No. 7, 1480-1481(Jul 1985). Contract AC03-76SF00098.

The characteristics of a small, water-cooled, 90° magnetic deflection mass spectrometer suitable for analyzing positive and negative hydrogen ion species is described.

32069 Composition measurement of aerosols of submicrometer particles by phase fluctuation absorption spectroscopy. Fluckiger, D.U.; Lin, H.; Marlow, W.H. (MIT Lincoln Laboratory, Lexington, Massachusetts 02173). *Applied Optics;* **24**: No. 11, 1668-1681(1 Jun 1985). Contract AC02-76CH00016.

Phase fluctuation optical heterodyne spectroscopy is employed to obtain the first nonextractive data on size-mass distribution of submicrometer ammonium sulfate aerosols. The required theory of aerosol absorption of electromagnetic energy and subsequent thermalization is presented. Based on this theory, the predicted behavior was confirmed by experiments using IR absorption of ammonium sulfate aerosols. The results show good agreement with measurements using conventional methods including condensation nuclei counter, electron micrography, and filtration. In addition, a conversion constant for the photothermal signal of ammonium sulfate aerosols is calculated to be $2.3\ \mu V/(\mu g/m^3)$. Furthermore, the signal is shown to be linear in excitation energy and modulation frequency and scalable.

32070 **Rapid scanning fluorometer based on constant energy synchronous scanning.** Jonell Kerkhoff, M.; Hart, L.P.; Winefordner, J.D. (Department of Chemistry, University of Florida, Gainesville, Florida 32611). *Review of Scientific Instruments;* **56**: No. 6, 1199-1205(Jun 1985).

A rapid scanning fluorometer based on constant energy synchronous fluorescence scanning at 200 nm/s has been developed. Constant energy synchronous fluorescence spectrometry involves measurement of fluorescence as both excitation and emission monochromators are scanned with a constant energy difference being maintained. Spectral information is collected in the forward to reverse directions and is processed in real time. A discussion of the instrumentation and software is given. A theoretical comparison between the photomultiplier tube (PMT) detection system used with this system and a silicon intensified target vidicon (SIT) detection system has been given. Calculations indicate that the signal-to-noise ratio S/N for the PMT system should be about 5—40 x greater than for the SIT system. A comparison of the experimental figures of merit (detection limits, scan speed, analysis time) of the rapid scan constant energy synchronous fluorescence spectrometer with video fluorometers has also been made, again showing the superiority of the rapid scan synchronous system.

32071 **Improved instrument for medium energy electron diffraction and microscopy of surfaces.** Elibol, C.; Ou, H.; Hembree, G.G.; Cowley, J.M. (Department of Physics, Arizona State University, Tempe, Arizona 85287). *Review of Scientific Instruments;* **56**: No. 6, 1215-1219(Jun 1985). Contract AC02-76ER02995.

The REMEDIE system for reflection electron microscopy and electron diffraction at intermediate energies (0.5—20 keV) has been rebuilt with an improved imaging resolution of better than 10 nm, a convenient and versatile system for observation diffraction patterns and provision for specimen preparation and treatment suitable for surface structural studies. The current capabilities of the instrument are illustrated by results obtained from cleaved and annealed silicon (111) surfaces with or without thin deposited silver and gold layers.

32072 **Single-pulse Raman scattering studies of heterogeneous explosive materials.** Trott, W.M.; Renlund, A.M. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Applied Optics;* **24**: No. 10, 1520-1525(15 May 1985). Contract AC04-76DP00789.

Raman scattering from ambient and shock-loaded heterogeneous (compressed pure polycrystalline) explosive materials has been examined using single-pulse laser excitation. In the case of triamino-trinitrobenzene (TATB), intense nonlinear scattering at 1170 cm^{-1} has been observed.

32073 **Measurement and calibration techniques used in computer partial pressure analysis.** Mitchell, D.J. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **3**: No. 3, 527-532(May 1985).

The uses of residual gas analyzers (RGA's) in computer controlled analytical studies and process monitoring applications are discussed in this paper. The relative merits are compared for the two most commonly used RGA's, which are the magnetic sector and the quadrupole mass analyzer. Methods of installing RGA's in vacuum systems and computer interfacing techniques are described. Measurement and calibration methods are outlined for applications where it is desirable to characterize either partial pressures or gas evolution rates. Interpretation of RGA spectra and limitations imposed by analytical errors are also discussed.

32074 **X-ray gauge measures areal density variations as small as 0.1%.** Stupin, D.M. (Materials Science and Technology Division, Los Alamos National Laboratory, Los Alamos, New Mexico, 87545). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **3**: No. 3, 1266-1268(May 1985). Contract W-7405-ENG-36.

A gauge measures areal density variations as small as 0.1% in low density plastic foams and other materials. It has a spatial resolution of 0.5 mm. This system is safe, portable, easy to use, and is readily automated. The 6-keV x-ray flux from a ^{55}Fe source is collimated to a 0.5-mm-diameter beam and attenuated by the sample. Transmitted x rays are detected with a proportional gas detector and counted with a scaler-timer. After measuring the x-ray attenuation in two areas of the sample, the areal density variation is calculated using an expression derived from $I/I_0 = \exp(-upx)$, where I is the transmitted flux, I_0 is the incident flux, u is the mass attenuation coefficient of the sample, p is the foam density, x is the thickness of the sample, and the product $px = D$ is the areal density. Measurements sensitive to 1% and 0.1% areal density variations take 3 min and 4 h per point, respectively, in 0.05-g/cm^3 plastics, 1 cm thick. Absolute areal density is also measured to +- 3% using existing x-ray attenuation tables. However, better accuracy may be obtained by calibrating the system with known samples.

32075 **Bistatic LIDAR experiment proposed for the shuttle/tethered satellite system missions.** McComas, D.J.; Spence, H.E.; Karl, R.R.; Horak, H.G.; Wilkerson, T.D. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Review of Scientific Instruments;* **56**: No. 5, 670-673(May 1985).

A new experiment concept has been proposed for the shuttle/tethered satellite system missions, which can provide high-resolution, global density mappings of certain ionospheric species. The technique utilizes bistatic LIDAR to take advantage of the unique dual platform configuration offered by these missions. A tuned, shuttle-based laser is used to excite a column of the atmosphere adjacent to the tethered satellite, while triangulating photometric detectors on the satellite are employed to measure the fluorescence from sections of the column. The fluorescent intensity at the detectors is increased about six decades over both ground-based and monostatic shuttle-based LIDAR sounding of the same region. In addition, the orbital motion of the shuttle provides for quasiglobal mapping unattainable with ground-based observations. Since this technique provides such vastly improved resolution on a synoptic scale, many important middle atmospheric studies, heretofore untenable, may soon be addressed.

32076 **Slit-scan flow cytometer for recording simultaneous waveforms.** Johnston, R.G.; Bartholdi, M.F.; Hiebert, R.D.; Parson, J.D.; Cram, L.S. (Experimental Pathology Group, Mail Stop M888, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Review of Scientific Instruments;* **56**: No. 5, 691-695(May 1985).

We have developed a slit-scan flow cytometer for recording the transient, simultaneous light scattering and fluorescence waveforms from individual metaphase chromosomes flowing through a focused laser beam. The two waveforms are recorded on a single-memory waveform recorder by delaying one of the waveforms and switching between them. The light scattering and fluorescence waveforms contain complementary information on chromosome structure. The delay and switching electronics developed here may be useful in other contexts.

32077 **Computer-controlled device for detection of nuclear resonance in transient radicals in liquids.** Nuttall, R.H.D.; Trifunac, A.D. (Argonne National Lab., IL). *Journal of Magnetic Resonance;* **51**: 118-123(1983). Contract W-31-109-ENG-38.

Modifications are discussed that were made to a Bruker WP80 FT NMR spectrometer to allow transitions among the nuclear sub-levels of transient radicals at any magnetic field to be detected in radicals created in liquid solution during pulse radiolysis. Effects observed in products for reacting radicals can be quite large. The NMR spectrometer had a 20-m cable between the console and magnet to allow placement of the console in the instrument room outside of the vault where samples were irradiated. The only effect on NMR performance was that a 90 pulse for protons was lengthened to approximately 9 sec. The most critical operation to automate was the adjustment of the tuning/matching capacitor setting for each new frequency. It was decided to prepare a calibration table by manually tuning the rf coil and having a computer routine interpolate capacitor settings from those in the table. Two tuning computer routines were written. The modifications have successfully automated the measurement of nuclear spectra of transient radicals using an NMR spectrometer.

4404 Well Logging Instrumentation

32078 (BHR—22) **Analytical model for a pulsed neutron gauge.** Oelgaard, P.L. (Danmarks Tekniske Hoejskole, Lyngby. Afdelingen for Elektrofysik). Sep 1983. 45p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85701253.

An analytical model for pulsed-neutron borehole gauges is developed. It takes into account the decrease of the γ-flux due both to thermal neutron absorption and to the movement of the neutrons away from the source. The model is one-dimensional, i.e. the effect of the borehole is not included. The fast neutrons are treated by use of Fermi-age theory, the thermal neutrons by use of diffusion theory. In the present version of the model the γ-detector is assumed to be very close to the pulsed source. The contribution of the scattered capture-γ-quanta to the γ-flux at the γ-detector is calculated by use of build-up factors. Numerical examples of the use of the model are presented. The model is compared with the usual, simplified model which assumes an exponential decay of the γ-detector count-rate. Formulas for the neutron slowing-down time and the thermal neutron lifetime are also presented together with numerical values of these lifetimes for various media of geological relevance.

32079 (PER—81, pp 39-40) **Computerisation of the NUCOR borehole logging unit.** Anderson, N.J.B.; Smit, C.J.B.; Heard, R. Jan 1984. NTIS (US Sales Only), PC A04/MF A01. File Number DE85780942. (CONF-8311245—Absts.).

From Symposium for researchers in nuclear geology; Pretoria, South Africa (23 Nov 1983).

Published in summary form only.

45 EXPLOSIONS AND EXPLOSIVES

4501 Chemical

REFER ALSO TO CITATION(S) 31831, 32072

32080 (AD-A—151737/4/XAB) **Material-response models and ground-motion calculations for high-explosive tests in G-Tunnel tuff. Technical report.** Patch, D.; Fogel, M. (Pacifica Technology, Del Mar, CA (USA)). 25 Jan 1984. 79p. (PT-U—83-0636). NTIS, PC A05/MF A01.

Numerical material-response models developed from static laboratory material-response measurements and from dynamic-explosive test data are described. Material models were first specified using only laboratory test data obtained by Terra Tek. Predictions using this model were then compared to dynamic stress and velocity data taken by SRI International in very small (3/8 gm PETN) explosive shots, and by Sandia Laboratories in a much larger scale (2000 lb. TNT) ONE-TON test. All laboratory measurements and SRI shots used tuff samples taken from the Sandia ONE-TON test site located in G-Tunnel at the Nevada Test Site. A new material model was constructed to agree as closely as possible with the SRI data and a second prediction for the ONE-TON event was made. Overall, the ONE-TON predictions were quite good if the expected bias in air-void content was considered, with the model using the SRI results doing slightly better. The comparisons highlighted concerns about the measured air-void content and uncertainties in the strain-rate dependence of material properties. Models including dilatation and viscoelastic effects were developed, and predictions from these models are compared with the test data. The viscoelastic model was quite successful at both the SRI and ONE-TON scale. The dilatation model had some encouraging features but requires additional data and development.

32081 (AD-A—152012/1/XAB) **Detonations of solid explosives. Final report, 1 November 1982-31 October 1984.** Brener, N.E. (Texas Univ., Arlington (USA)). 28 Dec 1984. 44p. NTIS, PC A03/MF A01.

The main goal of this project is to calculate the activation energy of explosive molecules. Progress has come in the form of four different approaches to the problem: (1) Configuration interaction method; (2) Guassian 82 Computer program; (3) MNDOOC procedure; and (4) Green's function techniques. Access is available to the first Cray version of Dr. Henry F. Schaefer's CI programs and to several large Cray computers on which to run the programs. As a result, very large and highly accurate CI calculations are expected on explosive molecules of interest. The Guassian 82 Computer Program is generally considered to be state-of-the-art program in the area of Moller-Plesset perturbation theory. A new Cray version of Guassian 82, not yet available to the general scientific community, is expected to yield activation-energy calculations that are better and more accurate values than those previously possible using Guassian 82. The MNDOC method, a new correlated version of the MNDO method, has been used to compute accurate values for the activation energy of methyl nitrate. Green's function theory has been used to derive a new one-electron equation that goes beyond previous one-electron equations to include higher-order correlation terms. As correlation plays a very important part in molecular reactions, this new equation is expected to lead to significant improvements in the calculation of molecular activation energies.

32082 (LA-UR—84-2753) **Theory of dense molecular fluid equations of state with application to detonation products.** Shaw, M.S.; Johnson, J.D.; Holian, B.L. (Los Alamos National Lab., NM (USA)). 1984. Contract W-7405-ENG-36. 4p. (CONF-850706—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE84016822.

From 8. international symposium on detonation; Albuquerque, NM, USA (15 Jul 1985).

Because of the uncertainty in using spherical potentials, a series of benchmark calculations was made using molecular dynamics with realistic anisotropic potentials. The configurational part of the Helmholtz free energy for an anisotropic molecular system can be obtained by using an equivalent spherical potential. Such potentials were obtained for N_2, O_2, NO, CO, and CO_2. (DLC)

32083 (LA-UR—85-742) **Three-dimensional hydrodynamic hot-spot model.** Mader, C.L.; Kershner, J.D. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 10p. (CONF-850706—6). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85009587.

From 8. international symposium on detonation; Albuquerque, NM, USA (15 Jul 1985).

The interaction of a shock wave with a single air hole and a matrix of air holes in PETN, HMX, and TATB has been numerically modeled. The hot-spot formation, interaction, and the resulting buildup toward detonation were computed using three-dimensional numerical Eulerian hydrodynamics with Arrhenius chemical reaction and accurate equations of state according to the hydrodynamic hot-spot model. The basic differences between shock sensitive explosives (PETN, HMX) and shock insensitive explosives (TATB, NQ) may be described using the hydrodynamic hot-spot model. The reactive hydrodynamics of desensitization of heterogeneous explosives by a weak preshock has been numerically modeled. The preshock desensitizes the heterogeneous explosive by closing the air holes and making it more homogeneous. A higher pressure second shock has a lower temperature in the multiple shocked explosive than in single shocked explosives. The multiple shock temperature may be low enough to cause a detonation wave to fail to propagate through the preshocked explosive. 10 refs., 12 figs.

32084 (LA-UR—85-769) Modeling heterogeneous high explosive burn with an explicit hot-spot process. Tang, P.K.; Johnson, J.N.; Forest, C.A. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 11p. (CONF-850706—5). NTIS, PC A02/MF A01; GPO Dep. File Number DE85009593.

From 8. international symposium on detonation; Albuquerque, NM, USA (15 Jul 1985).

We present a method of treating high explosive burn with a multi-step process which includes the hot-spot excitation, decomposition, and the propagation of reaction into the region outside the hot spots. The basic features of this model are the separation of the thermal-mechanical and chemical processes, and the partition of the explosive into hot spots and the region exclusive of the hot spots. The thermal-mechanical aspects are formulated in a way similar to the chemical process. The combined processes lead to a set of rate equations for the mass fractions of reactants, intermediate states, and final products. The rates are expressed initially in terms of general characteristic times, but with specific phenomenological correlations introduced in the final model. Computational examples are given of simulated flyer plate impacts, short-shock initiation, corner turning, and shock desensitization. 19 refs., 9 figs.

32085 (LA-UR—85-860) Real time analysis of PETN detonation products. Blais, N.C.; Valentini, J.J. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 8p. (CONF-850706—8). NTIS, PC A02/MF A01; GPO Dep. File Number DE85009581.

From 8. international symposium on detonation; Albuquerque, NM, USA (15 Jul 1985).

The freely expanding gases from the detonation of pentaerythritol tetranitrate (PETN) pellet were analyzed as rapidly as the molecules arrived at the mass spectrometer detector. It was found that all of the products arriving at the detector earliest, irrespective of mass, had the same velocity, 11 km s^{-1} and peaked at 5 km s^{-1}. The width of the time distributions varied from one species to another. Mass and velocity spectra of the important products were obtained and the most intense signals were found to be H_2O, CO, and CO_2, but H_2O was by far the largest. Smaller signals arising from O, HCN, HCO, and NO_2 were also found. Comparisons of the spectrum with other experiments are discussed. 8 refs. 5 figs.

32086 (LA-UR—85-1023) Effect of precipitation variables on the specific surface and explosion characteristics of pentaerythritol tetranitrate. Dinegar, R.H. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 11p. (CONF-850742—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE85009620.

From International Pyrotechnics Society symposium; Karlsruhe, F.R. Germany (3 Jul 1985).

The particle size, shape, and texture of the crystals of pentaerythritol tetranitrate (PETN) precipitated from acetone solutions by the addition of water depend upon many crystallization factors. Among the most important of these are 1) the concentration of PETN in the acetone, 2) both the volume of water and the rate at which the nonsolvent is added, and 3) the amount of agitation of the solution during the precipitation process. Fortunately, all of these conditions can be controlled easily because the explosion characteristics of PETN are strong functions of the crystal description. This paper quantitatively describes the effect of precipitation conditions on the type of PETN crystals obtained and the variation of both explosive sensitivity and explosion time with one important quantitative measure of crystal description: the area per unit mass or specific surface. 2 refs., 2 figs., 8 tabs.

32087 (LA-UR—85-1088) Electron density distribution analysis for nitroguanidine. Ritchie, J.P.; Cromer, D.T.; Stewart, R.F.; Wasserman, H.J.; Ryan, R.R. (Los Alamos National Lab., NM (USA); Carnegie-Mellon Univ., Pittsburgh, PA (USA). Dept. of Chemistry). 1985. Contract W-7405-ENG-36. 10p. (CONF-850706—4). NTIS, PC A02/MF A01; GPO Dep. File Number DE85009598.

From 8. international symposium on detonation; Albuquerque, NM, USA (15 Jul 1985).

The electron density distribution of nitroguanidine was analyzed with both experimental and theoretical techniques to determine how well these methods would work for an explosive molecule. Explosives present special problems with these methods because many atoms are usually involved, which can cause the calculations to become intractable, and because the molecules have many polar bonds. We found that, although the polar character of the space group made the experimental analysis difficult, the two techniques yielded results very much in harmony. Specifically, electrostatic potentials, which play a large role in determining crystal geometry, were in very good agreement. A discrepancy, however, was observed between the theoretically optimized geometry and the observed geometry. This discrepancy appears to be the result of crystal packing forces which are not present in the theoretical calculations. We also observed some similarities between the hydrogen-bond network in NQ and that in TATB. 14 refs., 9 figs., 2 tabs.

32088 (LA-UR—85-1122) Detonation in tungsten-loaded HMX. Goldstein, S.; Mader, C.L. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 7p. (CONF-850706—7). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85009606.

From 8. international symposium on detonation; Albuquerque, NM, USA (15 Jul 1985).

The detonation behavior of X-0233, a heavily tungsten-loaded HMX explosive, has been studied using failure diameter measurements, plate dents, and aquarium tests. A model with features resembling those of a weak detonation describe the experimental results. 7 refs., 10 figs.

32089 (LA-UR—85-1130) Intermolecular explosives. Akst, I.B. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 11p. (CONF-850706—10). NTIS, PC A02/MF A01; GPO Dep. File Number DE85009609.

From 8. international symposium on detonation; Albuquerque, NM, USA (15 Jul 1985).

The steady-state detonation characteristics of a few intermolecular explosives are examined along with results of wedge experiments on initiation and reaction growth in one system (EAK), toward a better understanding of this class of explosives. The importance of factors such as products and their states, and temperature, to performance of these systems and explosives in general is discussed. Hydrogen compounds may be superior enough to carbon and its compounds as fuels and products for quick metal-accelerating explosives that the effect of the generally lower density is offset. High temperatures and condensation of solid products are probably the main causes of late appearance of energy in metal motion. The unusual shock sensitiveness and explosiveness of EAK are indicated by wedge results including pseudo-Pop-plots of overtaking waves, and by plots of shock velocity versus transit distance in the wedges. 20 refs., 10 figs., 2 tabs.

32090 (LA-UR—85-1390) Sensitivity and performance characterization of DINGU. Stinecipher, M.M.; Stretz, L.A. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 7p. (CONF-850706—18). NTIS, PC A02/MF A01; GPO Dep. File Number DE85010750.

From 8. international symposium on detonation; Albuquerque, NM, USA (15 Jul 1985).

DINGU, as a relatively insensitive high explosive (HE), may have interesting applications. We have been working on better methods for preparation and characterization. We have achieved a particle size suitable for formulating this compound into a PBX and have tested DINGU/binder by plate dent. We have compared the sensitivity of DINGU with that of TATB in small-scale tests. 14 refs., 2 figs., 3 tabs.

32091 (MLM—3252) Friction, impact, and electrostatic discharge sensitivities of energetic materials. Wang, P.S.; Hall, G.F. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 31 May 1985. Contract AC04-76DP00053. 21p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85013321.

Impact, friction, and electrostatic discharge sensitivities of energetic materials (explosives and pyrotechnics) used or manufactured at Mound were tested by the "one-shot" method. The Bruceton statistical method was used to derive 50% initiation levels, and the results were compared. The materials tested include: PETN, HMX, Plastic Bonded Explosives (PBX), CP, TATB, RX26BB, RX26BH, barium styphnate, LX-15, LX-16, Ti/$KClO_4$, TiH/sub 0.65//$KClO_4$, TiH/sub 1.65//$KClO_4$, Fe/$KClO_4$, TiH/sub 1.75// B/$CaCrO_4$, Ti/B/$CaCrO_4$, B/$CaCrO_4$, TiH/sub 0.65//2B, TiH/sub 0.65//3B, 2Ti/B, TiH/sub 1.67//2B, Ti/2B, TiH/sub 1/67//3B, Ti/B, and Ti/3B. Some samples were investigated for aging effects, physical variables, and the effect of manufacturing paramters on sensitivities. The results show that in both friction and impact tests, CP and barium styphnate are the most sensitive; TiH/sub 1.65/ $KClO_4$, LX-15, TATB and its related materials are the least sensitive; and other materials such as PETN and HMX are in the midrange. In the electrostatic tests of Ti-based pyrotechnics, a decrease of sensitivity with increasing hydrogen concentration was observed. 20 refs., 12 figs., 7 tabs.

32092 (SAND—84-1825C) Pressure-shear loading of PBX-9404. Chhabildas, L.C.; Kipp, M.E. (Sandia National Labs., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 19p. (CONF-850706—15). NTIS, PC A02/MF A01; GPO Dep. File Number DE85009982.

From 8. international symposium on detonation; Albuquerque, NM, USA (15 Jul 1985).

Pressure-shear loading techniques have been used to obtain estimates of dynamic shear strength of PBX-9404 over the stress range of 0.3 to 1.0 GPa. One dimensional pressure-shear waves were generated with a single-stage compressed gas gun. The gun was used to obtain normal impact of a projectile on a Y-cut quartz crystal with an explosive sample bonded to its rear surface. The anisotropic nature of the Y-cut quartz results in a two-wave structure having particle velocities in both the longitudinal and transverse directions. Results of these experiments indicate that a maximum shear stress of 0.04 GPa is obtained over the stress range studied. The pulse amplitude and the sample thickness in the present experiments are not optimal to investigate the reaction sensitivity to shear loading. Numerical simulations of these experiments based on an existing thermomechanical model and an elastic, perfectly plastic model, are also reported. 23 refs., 7 figs.

32093 (SAND—84-1844C) Explosive initiation by very small conical shaped charge jets. Vigil, M.G. (Sandia National Labs., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 11p. (CONF-850706—9). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85009443.

From 8. international symposium on detonation; Albuquerque, NM, USA (15 Jul 1985).

Very small conical shaped charge (CSC) jets were used to initiate four different secondary explosives. The liner thicknesses varied between 0.076 and 0.127 mm. LX-13 (80% PETN and 20% SYLGARD) explosive was used to drive the conical liners to form the CSC jets. The CSC jet velocities varied between 3.6 and 6.5 mm/μs. The jet tip diameters ranged between 0.041 and 1.10 mm. The explosive acceptor or target diameters were varied between 1.90 and 19.1 mm. The lateral confinement of the acceptor explosives was minimal. Relationships for critical jet initiation energy and dimensionless explosive/jet parameter as a function of initiation parameters are developed. The jet initiation data from this investigation as well as previously published data are shown to be consistent with the developed relationships. The threshold initiation parameter (jet velocity squared times jet diameter) for LX-13, PETN, PBX-9407, and TETRYL were experimentally determined to be 0.011, 0.0130, 0.041, and 0.044 $cm^3/\mu s^2$, respectively, for copper jets impacting bare explosive acceptors. The lower values for the LX-13 and PETN indicate these two explosives are more sensitive to shock initiation than PBX-9407 and TETRYL explosives. 14 refs., 9 figs., 6 tabs.

32094 (SAND—84-1860C) Modeling granular explosive detonations with shear band concepts. Kipp, M.E. (Sandia National Labs., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 8p. (CONF-850706—20). NTIS, PC A02/MF A01; GPO Dep. File Number DE85011823.

From 8. international symposium on detonation; Albuquerque, NM, USA (15 Jul 1985).

In theories that are formulated to describe shock-induced reactions in granular explosives, it is necessary to identify and model mechanisms that contribute to the growth or decay of the reaction. The concept of hot spot formation and subsequent reaction is examined on the basis of recent work on shear-band nucleation. In this context, the energy dissipated by the shock preferentially heats a volume fraction of the material to a relatively high local temperature. Heat conduction takes place driving the temperatures toward equilibrium, in competition with the reaction of the heated material. As the amplitude of loading increases, the volume of nucleated hot material also increases, thus decreasing the volume of cold material remaining that must decompose by grain burning. 17 refs., 6 figs.

32095 (SAND—85-0761C) Experimental studies of chemical reactivity during shock initiation of hexanitrostilbene. Setchell, R.E. (Sandia National Labs., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 40p. (CONF-850706—19). NTIS, PC A03/MF A01; GPO Dep. File Number DE85011726.

From 8. international symposium on detonation; Albuquerque, NM, USA (15 Jul 1985).

A new experimental approach has been used to examine the release of chemical energy during shock initiation of hexanitrostilbene (HNS). In this approach, the intensity of visible emission from an explosive/window interface, integrated over the spectral range of 550 to 800 nm, was recorded in time as a measure of local chemical reactivity at this interface. Simultaneously, VISAR measurements were made of the particle velocity of the same interface in order to examine the relative effect of the energy release on the wave motion. Sustained and short-duration shocks, having pressures from 2.3 GPa to 4.0 GPa, were generated in two types of HNS materials that previously have shown significant differences in shock sensitivity. The emission intensity was found to be a very sensitive indicator of chemical reactivity. The combined measurements indicate that the temporal and spatial behavior of energy release during shock initiation is quite different in the two types of HNS. 21 refs., 15 figs.

32096 (UCRL—92102) Comparison of experimental data on detonation velocity and Chapman-Jouget pressure vs initial HE density with predictions from Ree's model equation of state. Steinberg, D.J. (Lawrence Livermore National Lab., CA (USA)). Feb 1985. Contract W-7405-ENG-48. 11p. (CONF-850706—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE85007266.

From 8. international symposium on detonation; Albuquerque, NM, USA (15 Jul 1985).

Data on the change of detonation velocity and Chapman-Jouget pressure vs initial HE density for RDX and HMX have been compared with the theoretical predictions of Ree for PBX 9404. Ree's model predicts breaks or changes in the slope of these curves due to the solidification of carbon and the formation of a separate, nitrogen-rich phase. There is good evidence for the solidification of carbon at rho$_0$ about 1.15 g/cc, but the evidence for the nitrogen phase separation at rho$_0$ about 1.56 g/cc is conflicting. 14 refs., 6 figs., 1 tab.

32097 Vapor explosions: a critical review. Bankoff, S.G. Evanston, IL; Northwestern University ([1985]). 6p.

Four stages of the vapor explosion phenomenon are distinguished: premixing, triggering, escalation and propagation. Fauske proposed that spontaneous nucleation upon contract of the hot and cold liquids was a necessary condition for the first three stages, while Board, Hall and Hall have proposed a thermal detonation theory based upon purely hydrodynamic fragmentation behind the shock front for the fourth stage. The evidence concerning both concepts is discussed, and some tentative conclusions drawn. Some data relevant to the triggering and escalation steps, together with some brief comments concerning cyclic propagation models, are presented.

4502 Nuclear

REFER ALSO TO CITATION(S) 31808

32098 **(AD—354288/3/XAB) High-altitude nuclear-detonation optical infrared effects.** Gauvin, H.P.; Cahill, J.P.; Grenier, J.W.; Carpenter, J.W. (Air Force Geophysics Lab., Hanscom AFB, MA (USA)). 14 Oct 1964. 384p. NTIS, PC A17/MF A01.

Report on Operation Dominic. Fish Bowl Series. Project 8A.1 (U).

Optical-IR radiation data were obtained on Shots Star Fish Prime, Check Mate, Blue Gill Triple Prime, King Fish, and Tight Rope from both aircraft stations and Johnston and Maui Island stations. The spectral radiance observed by each channel for each shot is presented in graphical form as a function of time. In general, data are presented from approximately H + 25 msec to as long as a signal above background was observed. No data on the initial pulse (H + 0.5 msec to approximately H + 25 msec) are shown.

32099 **(AD—360457/6/XAB) Piggyback satellite packages.** Bena, R.A.; Baker, K.; Giacconi, R.; Gursky, H.; Hinteregger, H. (Air Force Geophysics Lab., Hanscom AFB, MA (USA)). 3 May 1965. 270p. NTIS, PC A12/MF A01.

Report on Operation Dominic, Fish Bowl Series, Project 6.12 (U).

The purpose of the measurements proposed by Project 6.12 was to investigate the spread of fission debris around the globe and its effects on ionization and radio noise. It was assumed that for the high-altitude shot the fission debris would expand from the detonation point until it was stopped either by the magnetic containment or, in the case of downward-moving debris, by the denser air, causing ionization. A high content of atomic ions is formed in this way around 200 km in height and, due to the low recombination rate, is only slowly removed. The fission products eventually spread around the earth and, if charged, will form a belt. Another belt produced by the trapped fission betas is formed even faster. This belt was expected to emit synchrotron noise. To make these measurements of the world-wide and long-time effects, Discoverer satellites were instrumented with specially designed research packages. Because of the difficulties and schedule slippages encountered in attempting the nuclear detonations, this project was not able to obtain data during the time of primary interest.

32100 **(AD—473909/0/XAB) Operation Crossroads. Atomic bomb tests Able and Baker conducted at Bikini Atoll, Marshall Islands on 1 July 1946 and 25 July 1946. Volume 1. History of Director of Ship Material report.** (Joint Task Force One, Washington, DC (USA)). 1946. 156p. (XRD—189). NTIS, PC A08/MF A01.

See also Volume 3, AD-473 910.

The purpose of this history is to provide a general, nontechnical introduction to the voluminous technical reports evolving from Operation Crossroads. There are many reasons for such a history but it is enough to say here that any assessment of results in a large test operation must take into account in some manner how the results were obtained. The history, therefore, provides a chronological account of the effort, extending over a period of eight months, which the groups under the Director of Ship Material, as well as some other closely related groups, put forth to obtain the results that lie behind the technical reports.

32101 **(AD—473910/8/XAB) Operation Crossroads. Atomic bomb tests Able and Baker conducted at Bikini Atoll, Marshall Islands on 1 July 1946 and 25 July 1946. Volume 3. Appendix v: pictorial review. History of Director of Ship Material report.** (Joint Task Force One, Washington, DC (USA)). 1946. 114p. (XRD—191). NTIS, PC A06/MF A01.

See also Volume 1, AD-473 909.

32102 **(AD-A—151712/7/XAB) Laboratory investigation of containment of underground explosions. Technical report.** Cizek, J.C.; Florence, A.L. (SRI International, Menlo Park, CA (USA)). Dec 1983. 254p. NTIS, PC A12/MF A01.

In support of the DNA program for stemming and containment of underground nuclear tests, laboratory techniques were applied to investigate the mechanics of containing gases in cavities formed by underground nuclear explosions. One experimental technique uses constant-flow-rate hydrofracture from a central exploded cavity in a cylinder of geologic material or simulant externally pressurized to represent overburden. A second experimental technique uses the measurement of particle velocity in the material surrounding an exploded cavity to provide outward and rebound motion at several radii for geologic materials and simulants. Additional experimental techniques use direct measurements of the transient and long-term stress and strain surrounding an exploded cavity. Hydrofracture, particle velocity, stress, and strain results for a rock-matching grout representing saturated Nevada Test Site tuff show the following: a beneficial residual stress forms around and exploded cavity, and containment of gases is achieved at normal overburden. Permanent-volume compression exists in the region surrounding an exploded cavity. Containment may be possible with depth-of-burial and overburden less than those of normal practice. Strain-rate changes do not have significant effect on particle velocity when the scale factor is doubled.

32103 **(AD-A—152188/9/XAB) Analysis of radiation exposure for naval personnel at Operation Sandstone. Technical report.** Thomas, C.; Goetz, J.; Stuart, J.; Klemm, J. (Science Applications International Corp., McLean, VA (USA)). 15 Aug 1983. 52p. (SAI—83/1055). NTIS, PC A04/MF A01.

Radiation environments are reconstructed for Task Group 7.3 ships and the residence islands of Enewetak and Kwajalein Atolls resulting from the three nuclear detonations comprising Operation SANDSTONE (April-May 1948). Secondary (late-time) fallout was the source of virtually all of the radioactive contamination on the ships and islands, most of which resulted from Shots X-RAY and YOKE. Fallout from Shot ZEBRA was minimal. From the reconstructed free-field radiological environments, an equivalent personnel film badge dose is calculated and compared to actual dosimetry data obtained during the operation. Calculated doses and dosimetry are consistent, although most of the calculated and film badge doses are below film badge threshold.

32104 **(INIS-mf—9296) Densification and reactivity enhancement during the ignition of nuclear weapons. Pt. 1. An analytical approximation of the Guderley implosive densification.** Hafner, P. (Fraunhofer-Gesellschaft zur Foerderung der Angewandten Forschung e.V., Euskirchen (Germany, F.R.). Inst. fuer Naturwissenschaftlich-Technische Trendanalysen). Jul 1982. 41p. (In German). NTIS (US Sales Only), PC A03/MF A01. File Number DE85780927.

An analytical approximation is presented to describe the strongly convergent densification shock front in an ideal gas. With the model of an ideal medium, which is compressed with constant velocity at the boundary, and the similarity characteristics of the shock wave front it is assumed, that all particles move independently with their velocities obtained in the shock wave front. With this assumption, which primarily is valid for an implosion shock, the hydrodynamic equations can be solved analytically to give a simple description of the total flow field. For the case of the spherically symmetric compression shock the results are presented for different adiabate coefficients. (orig.).

32105 **(ORNL/Sub—83/43374/1/V3) Study to assess the effects of magnetohydrodynamic electromagnetic pulse on electric power systems. Phase I, final report. Volume 3.** Legro, J.R.; Abi-Samra, N.C.; Tesche, F.M. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Advanced Systems Technology Div.). May 1985. Contract AC05-84OR21400. 135p. NTIS, PC A07/MF A01. File Number DE85011301.

In addition to the initial transients designated as fast transient high-altitude EMP (HEMP) and intermediate time EMP, electromagnetic signals are also perceived at times from seconds to hundreds of seconds after a high-altitude nuclear burst. This signal has been defined by the term magnetohydrodynamic-electromagnetic pulse (MHD-EMP). The MHD-EMP phenomena has been both detected in actual weapon tests and predicted from theoretical models. This volume documents a preliminary research effort to investigate the nature and coupling of the MHD-EMP environments to electric power systems, define the construction of approximate system response network models, and document the development of a unified methodology to assess equipment and systematic vulnerability. The MHD-EMP environment is compared to a qualitatively similar natural event, the electromagnetic environment produced by geomagnetic storms.

32106 **(UCID—20423) Evaluation framework for Comprehensive Test Ban Treaty seismic verification systems.** Younker, L.; Hannon, J.; Springer, D.; Al-Ayat, R.; Judd, B.; Morris, P.; Sandling, J. (Lawrence Livermore National Lab., CA (USA)). Apr 1985. Contract W-7405-ENG-48. 45p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85013364.

This report describes an analytic framework for evaluating the capabilities of seismic systems for verifying future treaties limiting nuclear weapons tests. The framework, which is based on decision analysis, is intended to assist policy makers in formulating and evaluating political decisions and research alternatives related to seismic verification. An illustrative evaluation is provided for two types of seismic systems, which are part of an in-country Regional Seismic Verification System. The evaluation incorporates a variety of issues, including detection capabilities, evasion possibilities, evidence produced by the systems, US response to the evidence, and relative values of possible outcomes to the US and foreign countries. Methods are provided to quantify the effectiveness of the systems in assuring treaty compliance and deterring violations. The primary advantages of the framework are that it provides a systematic method for examining technical issues, incorporating value and cost tradeoffs, and analyzing alternate judgments. The framework is being refined to incorporate, for example, the role of on-site inspections and information provided by other sources that supplements seismic evidence. Applications of the framework to decisions related to treaty negotiations are being explored.

32107 **(UCRL—92523) Smoke inputs to climate models: optical properties and height distribution for nuclear winter studies.** Penner, J.E.; Haselman, L.C. Jr. (Lawrence Livermore National Lab., CA (USA)). Apr 1985. Contract W-7405-ENG-48. 27p. (CONF-8408122—3). NTIS, PC A03/MF A01; GPO Dep. File Number DE85011363.

From 4. international conference on nuclear war; Erice, Sicily, Italy (19 Aug 1984).

Smoke from fires produced in the aftermath of a major nuclear exchange has been predicted to cause large decreases in land surface temperatures. The extent of the decrease and even the sign of the temperature change depend on the optical characteristics of the smoke and how it is distributed with altitude. The height distribution of smoke over a fire is determined by the amount of buoyant energy produced by the fire and the amount of energy released by the latent heat of condensation of water vapor. The optical properties of the smoke depend on the size distribution of smoke particles which changes due to coagulation within the lofted plume. We present calculations demonstrating these processes and estimate their importance for the smoke source term input for climate models. For high initial smoke densities and for absorbing smoke (m = 1.75 - 0.3i), coagulation of smoke particles within the smoke plume is predicted to first increase, then decrease, the size-integrated extinction cross section. However, at the smoke densities predicted in our model (assuming a 3% emission rate for smoke) and for our assumed initial size distribution, the attachment rates for brownian and turbulent collision processes are not fast enough to alter the smoke size distribution enough to significantly change the integrated extinction cross section. Early-time coagulation is, however, fast enough to allow further coagulation, on longer time scales, to act to decrease the extinction cross section. On these longer time scales appropriate to climate models, coagulation can decrease the extinction cross section by almost a factor of two before the smoke becomes well mixed around the globe. This process has been neglected in past climate effect evaluations, but could have a significant effect, since the extinction cross section enters as an exponential factor in calculating the light attenuation due to smoke. 10 refs., 20 figs.

4503 Explosion Detection

32108 **(AD-A—151162/5/XAB) Testing the hypothesis of TTBT (Threshold Test Ban Treaty) compliance, and magnitude-yield regression for explosions in granite. Final technical report, 15 November 1982-30 December 1984.** Shumway, R.H.; Rivers, D.W. (Teledyne Geotech, Alexandria, VA (USA)). 30 Dec 1984. 53p. (AL—84-7). NTIS, PC A04/MF A01.

Verification of the Threshold Test Ban Treaty (TTBT) cannot be performed merely by estimating explosive yields on the basis of observed seismic magnitudes and concluding that a violation has occurred if one or more yield estimates exceed the TTBT limit of 150 kt. It is necessary to take into account the uncertainties in the seismic magnitudes, in the magnitude - yield relation, and especially in the magnitude bias between the test site at which the magnitude - yield calibration explosions were detonated and the test site of the explosions being monitored. For monitoring one explosion at a time, these uncertainties can be taken into account by placing confidence limits around the yield estimates. For verifying TTBT compliance of an ensemble of explosions considered as a whole, however, this technique cannot be used, since the confidence limits placed around the yield estimates of different explosions are correlated due to the use in every case of the same values of the parameters relating magnitude to yield. In order to examine TTBT compliance for groups of explosions, a test can be performed of the hypothesis that the yields have some fixed distribution in which all the values are less than 150 kt.

32109 **(AD-A—151367/0/XAB) Frequency dependence of q in the mantle underlying the shield areas of Eurasia. Final technical report, 15 November 1982-30 December 1984.** Der, Z.A.; Lees, A.C.; Cormier, V.F.; Anderson, L.; Burnetti, J. (Teledyne Geotech, Alexandria, VA (USA)). 11 Jan 1985. 148p. (AL—85-1). NTIS, PC A07/MF A01.

In Part I the results of short- and intermediate-period data analyses for the determination of a frequency-dependent Q model of the mantle under the shield areas of Eurasia are presented. The spectra of short-period P waves from nuclear explosions in the 1-8 Hz frequency range give t* sub p = approx. 0.15-0.2 seconds. Part II presents analyses of long-period data. Long-period multiple S and ScS phases observed in northern Europe were analyzed to determine mantle attenuation in the 0.02- to 0.2-Hz range under the Eurasian shield. Two groups of events are used: deep Far-Eastern earthquakes and large earthquakes near the edges of the shield areas of Eurasia. Part III provides the Q model. A large set of broadband data was analyzed to determine the frequency and depth dependence of Q for P and S waves under the northern shield areas of Eurasia. A wide range of techniques utilizing spectra, amplitude ratios and waveform modeling were used to derive apparent and absolute t* estimated for P and S waves covering the seismic band between 0.01 to 10 Hz. A supplement discusses methodologies for estimating t*(f) from Short-Period Body Waves and Regional Variations of t*(f) in the United States.

32110 **(UCID—20381) Marine Sample Exploitation Project: estimates regarding the sensitivity and technology for the detection of nuclear explosion debris in the marine environment.** Marsh, K.V.; Buddemeier, R.W. (Lawrence Livermore National Lab., CA (USA)). 4 Jun 1985. Contract W-7405-ENG-48. 11p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85013176.

The report discusses the possibility of detecting a small nuclear explosion in which most of the fission products are released to the ocean. The use of marine plankton as bioaccumulators is proposed to deal with the problem of dilution. 7 refs. (ACR)

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50 ENVIRONMENTAL SCIENCES, ATMOSPHERIC

32111 **(EPRI-EL—3972) Estimation of design wind speeds from short-term records. Final report.** Grigoriu, M. (Cornell Univ., Ithaca, NY (USA). Dept. of Structural Engineering). May 1985. 63p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920651.

Conventional methods of estimating wind speed for the design of transmission lines require data collected over 20 to 30 years. Using the method developed in this study, engineers can estimate design wind speeds from as few as 3 years of data. The proposed method had an average error of less than 1% for the 42 weather stations analyzed.

32112 **(N—85-17474) Guidelines for atmospheric measurements in support of electro-optical systems testing.** (Range Commanders Council, White Sands Missile Range, NM (USA)). Oct 1984. 35p. (AD-A—148090). NTIS, PC A03/MF A01.

The recommendations made by eight workshop panels organized to determine specifications for atmospheric measurements are outlined and working sessions are summarized. Measurement guidelines for meteorological parameters, gaseous and aerosol constituents, and transmission parameters are given.

5001 Basic Studies

REFER ALSO TO CITATION(S) 30617, 32136

32113 **(DP-MS—76-64) Estimating diffusion coefficients from meteorological data.** Pendergast, M.M. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1976. Contract AC09-76SR00001. 45p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85012563.

Meteorological data for four different time series were collected to compare direct and indirect methods for selecting stability categories used to determine coefficients in the calculation of downwind air concentrations from releases of atmospheric contaminants. The data set includes wind velocity and temperature observations between 2 and 335 m from the WJBF-TV Tower near Beech Island, South Carolina, and surface weather observations at Bush Field Airport, Augusta, Georgia. The direct method based on the standard deviations of horizontal and vertical wind direction, σ/sub θ/ and σ/sub phi/, provides the best estimates of the true stability category. Three indirect methods based on the vertical temperature gradient, surface weather observations, and the Richardson number were evaluated with these estimates. 18 refs., 4 figs., 7 tabs.

32114 **(NUREG/CR—4159) Comparison of the 1981 INEL dispersion data with results from a number of different models.** Lewellen, W.S.; Sykes, R.I.; Parker, S.F. (Aeronautical Research Associates of Princeton, Inc., NJ (USA)). May 1985. 200p. (ARAP—505). NTIS, PC A09/MF A01 - GPO. File Number TI85901493.

The results from simulations by 12 different dispersion models are compared with observations from an extensive field experiment conducted by the Nuclear Regulatory Commission at the Idaho National Engineering Laboratory in July, 1981. Comparisons were made on the bases of hourly SF_6 samples taken at the surface, out to approximately 10 km from the 46 m release tower, both during and following 7 different 8-hour releases. Comparisons are also made for total integrated doses collected out to approximately 40 km. Three classes of models are used. Within the limited range appropriate for Class A models this data comparison shows that neither the puff models or the transport and diffusion models agree with the data any better than the simple Gaussian plume models. The puff and transport and diffusion models do show a slight edge in performance in comparison with the total dose over the extended range approximate for class B models. The best model results for the hourly samples show approximately 40% calculated within a factor of two when a 15° uncertainty in plume position is permitted and it is assumed that higher data samples may occur at stations between the actual sample sites. This is increased to 60% for the 12 hour integrated dose and 70% for the total integrated dose when the same performance measure is used. None of the models reproduce the observed patchy dose patterns. This patchiness is consistent with the discussion of the inherent uncertainty associated with time averaged plume observations contained in our companion reports on the scientific critique of available models.

32115 **(UCID—20415) User's guide to the MATHEW/ADPIC models.** Rodriguez, D.J.; Greenly, G.D.; Gresho, P.M.; Lange, R.; Lawver, B.S.; Lawson, L.A.; Walker, H. (Lawrence Livermore National Lab., CA (USA); NUS Corp., Gaithersburg, MD (USA)). Mar 1985. Contract W-7405-ENG-48. 165p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE85012952.

This user's guide provides both an operational and theoretical summary of the MATHEW/ADPIC transport and diffusion models and supplemental codes needed to execute these models. These models calculate air concentration and ground deposition on a regional scale (up to 200 km) from continuous or instantaneous point sources. MATHEW is a three-dimensional meteorological data-adjustment model which supplies ADPIC with mean wind fields that are mass-consistent, three-dimensional, and representative of the available meteorological measurements (surface, tower, and upper-air soundings). The bottom boundary in this model is determined by grid cell estimates of the actual topographic features of a given site and its environs, which can play a very important role in defining or modeling regional-scale patterns. ADPIC is a three-dimensional, particle-in-cell transport and diffusion code capable of calculating the time-dependent dispersion of inert or radioactive air pollutants. In addition to MATHEW/ADPIC, three supplemental codes are required to provide input/output support. These codes, which are also discussed in this user's guide, are TOPOG, MEDIC, and PLOTOCONTR.

32116 **(UCRL—15475) Atmospheric boundary layer testing. Final project report.** Brandt, H.; White, B.R.; Burke, J.P. (California Univ., Davis (USA). Dept. of Mechanical Engineering). Jun 1982. Contract W-7405-ENG-48. 145p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE85012931.

Low-speed wind-tunnel studies have been conducted that examined mean velocity profiles and longitudinal turbulence quantities including the energy spectra for a zero-pressure-gradient turbulent boundary layer flow over a rough-to-smooth change in surface roughness. The flow examined modeled the lower 30 to 50 m of the urban atmospheric boundary layer. The wind-tunnel flow was developed over a 12 m long flow conditioning section where roughness elements occupied the lower 10 to 13% of a 70 cm thick boundary layer with the freestream velocity of approximately 3.0 m/s. The present results provided unique information concerning the wind tunnel simulation of the urban atmospheric boundary layer in the following areas: (1) the presence and growth of an "inner boundary layer" downstream of a step transition in surface roughness; (2) the enhancement of boundary layer thickness ad turbulence characteristics using vortex generators or spires; and (3) determination of the appropriate modeling length scales. 56 figs., 4 tabs.

32117 **(UCRL—15475-Suppl.2) Atmospheric boundary layer testing: hot-wire anemometry measurements of turbulent boundary layer flow past a two-dimensional obstacle. 1982-1983 equipment loan report. Supplement 2.** White, B.R.; Strataridakis, C.J. (California Univ., Davis (USA). Dept. of Mechanical Engineering). Nov 1984. Contract W-7405-ENG-48. 176p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE85012875.

Measurements of a zero-pressure-gradient turbulent boundary layer flow past a two-dimensional obstacle were made in the present study. Measurements were made for both smooth and rough surfaces using single and X hot-wire probes. The Reynolds number based on obstacle height and freestream velocity was about 15,302. Profiles of mean velocity, turbulent intensity and probability density functions in two dimensions were determined. Also, Reynolds stress profiles, energy spectra and second moments of energy spectra were obtained. From the results evidence emerged that upstream, over, and downstream of the obstacle there zones of recirculating flow. The flow-field was dominated by the obstacle presence, such that no distinction between smooth-and rough-surface measurements could be made.

32118 **(UCRL—15662) Evaluation of the 2DFLOW and hybrid complex-terrain dispersion models with the 1980 ASCOT data base from The Geysers. Final report.** Tesche, T.W.; Haney, J.L.; Morris, R.E. (Systems Applications, Inc., San Rafael, CA (USA)). Nov 1984. Contract W-7405-ENG-48. 59p. (ASCOT—84-8). NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85012960.

This study utilized data collected during 5 tracer experiments to test the predictive performance of two numerical, grid-based complex-terrain dispersion models - the 2DFLOW and Hybrid models. The 2DFLOW model was developed by researchers at Savannah River National Laboratory (Garrett and Smith, 1982, 1984); the Hybrid model was developed by Systems Applications, Inc., and has been applied to air quality problems and in model evaluation studies for several years (Tesche, 1983). This study closely parallels a more extensive model evaluation effort at The Geysers in which four models - Mathew, ADPIC, SMOG, Hybrid, and 2DFLOW - were evaluated with additional tracer experiments from the 1981 ASCOT program and from earlier tracer studies conducted between 1878 to 1980 (Tesche, Haney, and Morris, 1984a,b; Tesche, 1984). In Section 2, we provide a brief overview of the theoretical formulation of the 2DFLOW and Hybrid models. Section 3 presents simulation results for each model for the five 1980 ASCOT drainage experiments. We interpret these results in Section 4 and present our findings and conclusions in Section 5.

32119 **(UCRL—92502) Distributed emergency response system to model dispersion and deposition of atmospheric releases.** Taylor, S.S. (Lawrence Livermore National Lab., CA (USA)). Apr 1985. Contract W-7405-ENG-48. 8p. (CONF-8505137—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE85011847.

From 6. IFAC workshop on distributed computer control systems; Monterey, CA, USA (20 May 1985).

Aging hardware and software and increasing commitments by the Departments of Energy and Defense have led us to develop a new, expanded system to replace the existing Atmospheric Release Advisory Capability (ARAC) system. This distributed, computer-based, emergency response system is used by state and federal agencies to assess the environmental health hazards resulting from an accidental release of radioactive material into the atmosphere. Like its predecessor, the expanded system uses local meteorology (e.g., wind speed and wind direction), as well as terrain information, to simulate the transport and dispersion of the airborne material. The system also calculates deposition and dose and displays them graphically over base maps of the local geography for use by on-site authorities. This paper discusses the limitations of the existing ARAC system. It also discusses the components and functionality of the new system, the technical difficulties encountered and resolved in its design and implementation, and the software methodologies and tools employed in its development.

32120 **Measured atmospheric stability near Oak Ridge; Tennessee.** Sandusky, W.F. (Battelle, Pacific Northwest Labs., Richland, WA). *Journal of the Air Pollution Control Association;* **35**: No. 2, 121-126(Feb 1985).

Atmospheric stability data, as determined by two accepted regulatory methods, were obtained for three distinct levels at a site on the Department of Energy's reservation near Oak Ridge, Tennessee, to support a construction permit for a nuclear facility. Annual, seasonal, and diurnal data sets were compared and found to differ markedly. Comparison of concurrent data sets indicated little correlation of the predicted atmospheric stability class existed. Data were obtained by two methods. A vertical temperature gradient method ($\Delta T/\Delta Z$) indicated neutral atmospheric conditions existed for an elevated layer, while layers near the surface experienced large occurrences of both extremely unstable and stable conditions. This pattern was consistent for each season, except the variation was most pronounced during the summer. On a diurnal basis, data for the layers near the surface experienced the classic variation of stable conditions during the night and unstable conditions during the day. The elevated layer, however, showed a less pronounced variation of atmospheric stability conditions. Data obtained by the other method, the standard deviation of the horizontal wind direction method (σ/sub theta/), indicated primarily unstable atmospheric stability conditions for each measurement level above the surface, although the tendency was toward neutral conditions at elevated levels. Stability conditions varied only slightly for the highest level over the course of the day, whereas the lower level showed the largest variation, especially during the winter season. These differences in estimating the atmospheric stability class for the two methods can be attributed to the fact that one method, σ/ sub theta/, can account for unstable conditions resulting from nocturnal drainage winds that occur at the site. Thus, care must be used in determining atmospheric stability conditions if dispersion calculations are to be made.

32121 **Average diurnal behavior of surface winds during summer at sites in complex terrain.** Garrett, A.J.; Smith, F.G. III. (Savannah River Laboratory, E.I. du Pont de Nemours & Co., Aiken, SC 29808). *Journal of Applied Meteorology;* **24**: No. 2, 174-191(Feb 1985). Contract AC09-76SR00001.

Mean diurnal wind distributions from five surface stations in the rugged Geysers area of northern California were examined to determine how they were affected by the terrain. The one-dimensional slop-flow model of Garrett was abel to simulate the average diurnal wind distribution at the station with the simplest slope geometry and using only routine weather observations as input. Wind direction frequency distributions at the other four stations clearly could not be explained by a simple daytime upslope and nighttime downslope wind distribution. Winds blew perpendicular to canyon axes (simple katabatic and daytime upslope flow) or parallel to canyon axes (organized drainage and upvalley winds), depending on station location. Winds always blew upslope during the day, but at two stations the wind blen some night and downslope on the others. The upslope flow at night may have been caused by prevailing winds in one case, and by drainage winds flowing off an opposing slope and across the intervening riverbed in the other.

5002 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 29616, 29669, 29676, 29677, 29678, 29679, 29680, 29681, 29682, 29683, 29685, 30027, 30085, 30659, 30663, 30828, 31118, 31119, 31364, 31368, 31577, 31632, 31653, 31654, 31832, 32107, 32190, 32369, 32370

32122 **(BNL—35651) Methods for estimating materials in high-rise central business districts.** Lipfert, F.W.; Torpey, M.R. (Brookhaven National Lab., Upton, NY (USA)). Sep 1984. Contract AC02-76CH00016. 33p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85012529.

Methods and data bases are reviewed for inventorying quantities of exterior materials in place in high rise central business districts. It is concluded that no computerized data bases exist which provide all the necessary information in one place. Thus it is recommended that computerized office building directories be used to estimate total surface area, and statistical sampling coupled with correlation analysis be attempted to derive relationships for the percentage distribution of susceptible materials to acid rain or other air pollution.

32123 **(BNL—36327) Detailed description and performance of a passive perfluorocarbon tracer system for building ventilation and air exchange measurements.** Dietz, R.N.; Goodrich, R.W.; Cote, E.A.; Wieser, R.F. (Brookhaven National Lab., Upton, NY (USA)). Feb 1985. Contract AC02-76CH00016. 103p. (CONF-8404147—3). NTIS, PC A06/ MF A01; GPO Dep. File Number DE85011826.

From ASTM symposium on measured air leakage performance of buildings; Philadelphia, PA, USA (2 Apr 1984).

The manufacturing procedures and performance of a building air infiltration kit consisting of miniature passive perfluorocarbon tracer (PFT) permeation sources and passive adsorption tube samplers are described. Having four PFT-types available, homes and buildings with up to four separate zones can be fully evaluated under steady state conditions for the air infiltration and exfiltration rates from each zone as well as the air exchange rates between zones using this inexpensive and non-obtrusive field kit. Complete details on deployment in homes and on gas chromatographic analysis of the passive samplers are presented. Examples of total air changes per hour (ACH) results in several studies showed average values between 0.25 to 0.64 h^{-1}. A generalized correlation was used to characterize the leakiness of eleven homes in the US and Canada, showing ACH dependency only on inside-outside temperature difference, wind speed to the 1.5 power, and a subjective terrain factor; the approach has application in evaluating weatherization performance. Details of multizone measurements in four homes provided insight into the role of attics, crawl-spaces, and basements on the indoor air quality and weatherization needs for the living zone. 26 refs., 15 figs., 23 tabs.

32124 (BNL—36333) **Multizone infiltration measurements in homes and buildings determined with a passive perfluorocarbon tracer method.** Dietz, R.N.; D'Ottavio, T.W.; Goodrich, R.W. (Brookhaven National Lab., Upton, NY (USA)). Mar 1985. Contract AC02-76CH00016. 38p. (CONF-850606—5). NTIS, PC A03/MF A01; GPO Dep. File Number DE85011818.

From American Society of Heating, Refrigerating and Air-Conditioning Engineers' semiannual meeting; Honolulu, HI, USA (23 Jun 1985).

A miniature passive perfluorocarbon tracer system was successfully applied to the determination of air infiltration and exfiltration rates from each zone of a multizoned structure as well as the air exchange rates between zones in homes, multiple unit condominiums, naturally ventilated apartment buildings, and large commercial buildings with multiple air handling systems. Use of the multizone technique in indoor air quality assessments and air handling system stratification studies appears to be quite feasible with the availability of this measurement system. 16 refs., 8 figs., 6 tabs.

32125 (BNL—36428) **Systems study for the removal, recovery, and disposal of carbon dioxide from fossil fuel power plants in the US.** Steinberg, M.; Cheng, H.C. (Brookhaven National Lab., Upton, NY (USA)). Feb 1985. Contract AC02-76CH00016. 25p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85012274.

The present study is part of the research on prevention options and deals with controlling the CO_2 emission from fossil fuel burning power plants. Data from US fossil fuel fired power plants, which constitute the major point sources of CO_2, are used in this initial systems study of the removal, recovery, and disposal of CO_2 from stack gases. Ths US contributes about 30% of the world's total man-made CO_2 emission. Utilities are responsible for about 30% of the total US emissions. Estimates indicate that a reduction in the annual incremental atmospheric CO_2 content of up to 10% would be achieved by a CO_2 control system applied to US utility plants. 24 refs., 8 tabs., 6 figs.

32126 (CEA-CONF—7384) **DIAL lidar measurements of atmospheric pollutants (SO_2, O_3) during the Fos-Berre 83 experiment.** Capitini, R.; Ancellet, G.; Megie, G.; Pelon, J.; Renaut, D. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Aug 1984. 6p. (CONF-8408147—1). NTIS (US Sales Only), PC A02/MF A01. File Number DE85751349.

From 12. international laser radar conference; Aix-en-Provence, France (13 Aug 1984).

Two UV DIAL lidars have been designed by French organisms (CEA, CNRS, EERM) to measure the concentration and the spatial distribution of atmospheric pollutants. As a large area can be probed with these instruments, they have been used for the remote range-resolved monitoring of SO_2 and O_3 during the 6th European Pollution Campaign. SO_2 and O_3 profiles and vertical sections were performed in the atmosphere polluted by the waste products released by the refineries, more especially in stable meteorological conditions with a weak wind aloft. For SO_2 in a range of 3 km a spatial resolution of 300 to 500 m and a time resolution of 3 to 5 mn are obtained. For O_3 in a range of 2.5 km a spatial resolution of 150 to 500 m and a time resolution of 3 to 15 mn are obtained. In both cases statistical error is below 20 ppb. Measurements are validated and compared to other DIAL lidars.

32127 (DOE/CE—0091/1) **Indoor air pollution.** (Conservation and Renewable Energy Inquiry and Referral Service, Silver Spring, MD (USA)). May 1985. Contract AC01-83CE30780. 3p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85013097.

FS 185, 2nd edition.

This factsheet reviews what is currently known about pollutant sources, abatement and control equipment and techniques for poorly ventilated houses. Radon, formaldehyde, tobacco smokes, carbon dioxide, carbon monoxide, particulates, bacteria, fungi and viruses are addressed. (PSB)

32128 (DOE/ER/10231—T1, pp 109-117) **International problems: ramifications of the carbon dioxide fossil fuel issue.** Cooper, C.L. (Institute for Energy Analysis, Oak Ridge, TN). 1984. NTIS, PC A07/MF A01. File Number DE85004706.

In Focus: energy issues for the eighties.

The carbon dioxide (CO_2) may be second only to nuclear war as the most challenging issue of the times. The use of fossil fuels and changing land use patterns have caused the problem, but the connection of CO_2 to the greenhouse effect has only recently caused concern over possible climatic effects from the doubling of concentration that will occur in the 21st century. A major uncertainty is the dynamics of international cooperation. The solution of the problem will involve global decisions, although actions by the major energy-consuming countries will be the deciding factor. Scientists are still uncertain about how 2-3°C changes in temperature will affect precipitation and agriculture. 3 figures, 1 table.

32129 (DOE/ER/10231—T1, pp 119-141) **Global carbon geosystem.** Dahlman, R. (Dept. of Energy, Washington, DC). 1984. NTIS, PC A07/MF A01. File Number DE85004706.

In Focus: energy issues for the eighties.

An overview of the global carbon dioxide (CO_2) problem discusses the carbon systems and carbon cycle and the possible impacts of massive geophysical changes from the release of a large quantity of CO_2 through the burning of fossil fuels. The author reviews current knowledge, DOE research programs, and a model for mitigating atmospheric CO_2 effects on climate and vegetation. Possible options for mitigation involve learning more about the role of the oceans and vegetation in maintaining a balance in the carbon cycle. 15 figures.

32130 (DOE/ER/60081—T2) **Climate modeling: a retrospective-prospective view with consideration for the atmospheric carbon dioxide-climate issue.** Sandahl, C.A.; Shieh, S.J. (InterAmerica Research Associates, Inc., Rosslyn, VA). 29 Jun 1984. Contract AC01-82ER60081. 121p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE85011532.

This paper provides a retrospective-prospective view of scientific and technological developments that led to our present capability to predict climate, with particular emphasis on the potential impact of increased atmospheric carbon dioxide, through the use of computer models of the earth-atmosphere system. This view is illustrated by means of a "technology tree" that traces out the history of key developments. The trunk of the tree represents present competence; the limbs and branches represent antecedent work and interrelationships therein. The technology tree provides a perspective of overall progress, shows where events have come together to provide substantial advancements, exposes areas where progress may be slower than desired, and indicates profitable directions for future work. 14 figs., 7 tabs.

32131 (DOE/ER/60106—2) **Lake ice occurrence as a possible detector of atmospheric CO_2 effects on climate. Second annual progress report, 1 December 1983-31 May 1985.** Barry, R.G. (Colorado Univ., Boulder (USA). Cooperative Inst. for Research in Environmental Sciences). May 1985. Contract AC02-83ER60106. 54p. NTIS, PC A04/MF A01; GPO Dep. File Number DE85012987.

A study has been made of the temporal and spatial patterns of the freeze-up and break-up of lakes in the sub-arctic and middle latitudes of the northern hemisphere, in an attempt to identify the potential effects of warming due to CO_2 and other greenhouse effects. Historical records of lake freeze-up/break-up dates and daily temperature at "neighbouring" meteorological/climatological stations have been analyzed in order to determine the degree of variance in the lake ice event dates that can be accounted for by simple temperature indices. Lake ice is a prime candidate for "first effects detection" of CO_2-induced warming because: (1) it shows a high degree of sensitivity to a single meteorological variable (temperature); (2) it has a short response time to temperature anomalies; (3) a single (in most cases), readily identifiable event (i.e., freeze-up/break-up) is the response to some integral of seasonal temperature conditions; (4) historical records are available to establish lake ice-temperature relationships; (5) freeze-up/break-up of lakes is recorded at a wide network of sites and, in addition, it can be readily monitored by operational satellite data.

32132 **(DOE/EV/02986—T1) Throughfall rate and chemistry studies: Whiteface Mountain.** Kadlecek, J.A.; Mossl, B. (State Univ. of New York, Albany (USA). Atmospheric Sciences Research Center). [1985]. Contract AC02-76EV02986. 30p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85012407.

Ranges of site dependent variability in precipitation quantity and chemical composition were studied with the following recommendations. At the 2000 ft level, the distribution of collected volumes is event dependent and normalization by open collection does not help. Averages based on approximately 5 to 10,000 cm^2 collection area should give results commensurate with uncertainties normally found in precipitation sampling. Troughs and buckets of equivalent areas give similar results. Wet precipitation is the primary mechanism for dominant inorganic ion deposition. However, near summit level, additional collection area will be required to reduce the sampling uncertainties. Throughfall deposition was enriched in this study, relative to rain, by a factor of about 6 for SO_4^{2-} and 4 for H^+. The uncertainty in these values is large, but enrichment does occur. The authors postulate that cloud capture is the primary source. (PSB)

32133 **(DOE/EV/10610—4) Model projections of time-dependent response to increasing carbon dioxide. Final report.** Hoffert, M.I.; Flannery, B.P. (New York Univ., NY (USA). Dept. of Applied Science). May 1985. Contract AC02-81EV10610. 63p. (NYU/DAS—85-137). NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85013326.

The state-of-the-art of mathematical models of transient climate change from historical and projected increases in atmospheric carbon dioxide and related factors is reviewed, including studies done at NYU and elsewhere. Major conclusions are: (1) the transient climate changes over 10 to 100 year timescales are probably driven by several "external" factors acting simultaneously, as well as "internal" factors such as variations in ocean dynamics; (2) the response of global temperature to this forcing is not instantaneous, but is delayed by times of the order 10 to 100 years by thermal damping by the upper ocean; (3) the development of reliable models is hampered by lack of a clear validation strategy for testing models against observations; (4) when run with standard scenarios, current models predict a global warming of the order of 1°C by the year 2000 relative to 1850, with an additional 2 to 5°C over the next century; However, the sensitivity of these predictions to uncertainties has not been sufficiently explored. Specific research programs are recommended to improve our ability to predict transient climatic changes from continued fossil fuel burning.

32134 **(DOE/NBB—0070) Two dimensional CO_2-ocean model including the biological processes.** Baes, C.F. Jr.; Killough, G.G. (Oak Ridge National Lab., TN (USA)). May 1985. Contract AC05-84OR21400. 38p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85012341.

A two-dimensional (latitude X depth) multi-box model of the ocean has been developed and used to predict the distribution of carbon dioxide between the ocean and the atmosphere. The model simulates the chemical and biological processes in the ocean that affect this distribution (i.e., ocean-atmosphere exchange of CO_2, photosynthesis and decay, calcium carbonate production and dissolution) by means of linear functions. The boxes are arranged to simulate isothermal regions in an idealized world ocean and the numerous flows are adjusted by means of three diffusivity parameters. In steady-state calculations, the concentrations of the various forms of carbon, dissolved oxygen, nutrient, alkalinity, and ^{14}C in each box are determined by matrix methods with three boundary conditions specified, namely, the partial pressure of CO_2 in the atmosphere and the nutrient concentration and alkalinity in one box. If the concentration of nutrients is doubled, P/sub a/ is nearly halved. Halving the rate of circulation lowers P/sub a/ by about 10%. Warming of the ocean increases P/sub a/ by about the amount expected (4%/°C) from the temperature coefficient of P/sub a/ when total dissolved carbon and alkalinity are held constant. Time integrations of the model beginning from a steady-state condition at various times in the last century show that for carbon uptakes (X_0) of less than about 100 Gt(Pg), the rate of uptake (in Gt/y) is approximated by $dX_0/dt = 0.0287$ (X/sub a/ - X_0), where X/sub a/ is the excess carbon in the atmosphere, and is otherwise almost independent of the scenario assumed for the variation of P/sub a/ with time. As X_0 increases further, the rate of uptake shows increasing negative deviations from this correlation. 36 refs., 10 figs., 11 tabs.

32135 **(DOE/OR/21400—T123) Effects of acid rain on forest nutrient status. Final report.** Johnson, D.W.; Cole, D.W. (Oak Ridge National Lab., TN (USA)). Apr 1985. Contract AC05-84OR21400. 45p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85012486.

In five forest sites (three in eastern Tennessee and two in western Washington) the effect of natural carbonic acid production on soil leaching was equaled or exceeded by that of atmospheric acid inputs. In a nitrogen-fixing red alder site in Washington, however, internal leaching by nitrification and nitric acid formation far exceeded atmospheric H^+ inputs at any site. All other sites retained NO_3^-, and soil SO_4^{2-} adsorption reduced the effectiveness of atmospheric H_2SO_4 inputs on soil leaching in two of the Tennessee sites and in the Washington red alder site. Atmospheric sulfur inputs exceeded the forest sulfur requirement in all five sites. Decomposer invertebrates appeared to be affected negatively by unrealistically large applications of SO_4^{2-}, either as $KHSO_4$ or K_2SO_4. Forest floor buffering prevented large changes in pH with acid SO_4^{2-} treatments. Results indicate that effects of acid deposition on decomposer invertebrates are unlikely except at input levels much higher than ambient.

32136 **(DOE/PC/71253—2) Elemental tracers of source regions of contaminants in precipitation. Second quarterly report.** Rahn, K.A.; Heaton, R. (Rhode Island Univ., Narragansett (USA). Graduate School of Oceanography). 1 Jun 1985. Contract FG22-84PC71253. 11p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85012858.

To date, we have sampled eight precipitation events, each with daily aerosol samples before, during, and after. Analytical data are complete for the first five events, and are presented. Improvements in sampling and analytical blanks are reported as well as analytical procedure.

32137 **(GSF-BPT—6/84) Improved knowledge on the climatology of the vertical ozone layer by means of balloon-borne ozone soundings.** Attmannspacher, W.; Hartmannsgruber, R.; Lang, P. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Bereich Projekttraegerschaften). Jun 1984. 46p. (In German). NTIS (US Sales Only), PC A03/MF A01. File Number DE85752001.

The behaviour of ozone through the year and the deviations from these data were measured by means of ozone soundings. Stratospheric ozone concentrations were found to be lower than the long-period means. In contrast, increasing ozone values were measured in the troposphere, although these did not compensate the stratospheric decrease.

32138 **(GSF-BPT—9/84) Influence of the biosphere on the release of N_2O from mineral nitrogenous fertilizers.** Conrad, R.; Seiler, W. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Bereich Projekttraegerschaften). Jun 1984. 59p. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE85752004.

Within a test station near Mainz and in sites in Andalusia, measuring devices were installed in defined areas and put into operation only half a year later. Thus similar rates of NO_2 emission between the individual areas of measurement were obtained. The kind of fertilizer was seen to have a marked influence on the quantity of the NO_2 emission. The influence of the quantity of fertilizer used and its form of application is due to local concentrations of nitrogen and thus to the microbial decomposition of nitrogen. Precipitations and daily variance are also of consequence.

32139 **(Juel-Spez—279) Methods of the ecotoxicological evaluation of chemicals. Photochemical degradation in the gas phase. Vol. 6.** Becker, K.H.; Biehl, H.M.; Bruckmann, P.; Fink, E.H.; Fuehr, F.; Kloepffer, W.; Zellner, R.; Zetzsch, C. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Projekttraeger fuer Umweltchemikalien). Nov 1984. 124p. NTIS (US Sales Only), PC A06/MF A01. File Number DE85752002.

Chemical degradation in the atmosphere is a result of direct and indirect photochemical reactions. It is now a well established fact that, among the homogenous gas phase processes, reactions initiated by the hydroxyl (OH) radical provide the most important degradation routes. This is based on the OH reactivity, as expressed by the rate coefficient ksub(OH), and the atmospheric OH concentration level. The present work contains the results of a comprehensive determination of the OH reactivity performed in different laboratories in Germany. The present report begins with a detailed description of the different experimental techniques applied within this project; in the following the results obtained from both, absolute and relative techniques are summarized in tabular form. Moreover, the use of laboratory kinetic data in order to estimate lifetimes of chemicals in the atmospheric environment and problems associated with this procedure will be discussed in the last section.

32140 **(N—85-16319) NOx emissions near a heat pump with gas motor.** Hendriks, T.P.M.; Visser, J.C. (British Gas Corp., London). Jul 1984. 27p. (BLL-WH—782-(9091.9F); T—6357/BG/WH782/84). British Library Lending Div., Boston Spa, England.

The area near the installation building of a heat pump driven by a gas motor was studied to determine whether concentrations of combustion gases occur which may have long term harmful effects on public health. In addition, the extent to which the dilution of combustion gases a very short distance from the building can be described by means of currently known air pollution transport models was investigated. At no single measurement point around the heat pump building did nitrogen oxide emission concentrations exceed 25 ppb, the 50-percentile value in the health standards for outside air.

32141 **(N—85-16324) CSIRO (Australia) atmospheric carbon dioxide monitoring program: surface data.** Beardsmore, D.J.; Pearman, G.I.; Obrien, C. (Commonwealth Scientific and Industrial Research Organization, Mordialoc (Australia). Div. of Atmospheric Physics). 1984. 120p. NTIS, PC A06/MF A01.

The Commonwealth Scientific and Industrial Research Organization (CSIRO) surface carbon dioxide monitoring programs at the Australian BAPMoN station at Cape Grim in Tasmania, the subAntarctic station at Macquarie Island, Mawson on the Antarctic mainland, Wilbinga in Western Australia, and from ships in the Southern Ocean are described. Background composition of the atmosphere was studied. The techniques and data handling procedures for the surface observation program, summary data, and the complete archived data sets are described. It is concluded that the present concept is a satisfactory basis on which to provide data for use in the global carbon cycle context.

32142 **(PB—85-153906/XAB) Review of national emission standards for mercury.** (Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards). Dec 1984. 72p. (EPA—450/3-84/014). NTIS, PC A04/MF A01.

This report presents the findings of the 5-year review of the national emission standards for mercury. Industries subject to the existing standard are mercury-cell chlor-alkali plants, sludge drying and incineration plants, and mercury-ore-processing facilities. Information and estimates are presented concerning processes, mercury emissions, control technology, compliance status, and industry growth. Information is presented about other industry source categories which have mercury air emissions, but are not regulated by the standards.

32143 **(PB—85-155943/XAB) Development of a model to estimate dispersion of elevated releases in the shear-dominated boundary layer. Final report.** Venkatram, A.; Paine, R. (Environmental Research and Technology, Inc., Concord, MA (USA)). May 1984. 105p. NTIS, PC A06/MF A01.

Pollutant emissions from tall stacks can give rise to high ground-level concentrations during what are commonly characterized as neutral conditions. This report describes a new model to estimate dispersion under high wind conditions. The model incorporates our latest understanding of the structure of the shear-dominated stable boundary layer. Vertical inhomogeneity is treated with two different sigma-z values corresponding to the upper and lower parts of the plume. The model has been evaluated against observations of ground-level concentrations measured at monitors in the vicinity of two power plants in the Midwest. Model testing inddicates that the model represents a significant improvement over currently available models.

32144 **(PB—85-157378/XAB) Computer-controlled acquisition of corrosion-rate data from multiple sensors.** Kendig, M.; Jeanjaquet, S.; Mansfeld, F. (Rockwell International Corp., Thousand Oaks, CA (USA). Science Center). Jan 1985. 19p. NTIS, PC A02/MF A01.

Determination of the polarization resistance from multiple sensors under computer control provides rapid, reproducible, and accurate means for determining corrosion rates ranging over many orders of magnitude for large test matrices. Computerized techniques can simultaneously evaluate the response of many sensors to variations in the composition of a corrosive environment. Examples are presented of computerized corrosion monitoring of atmospheric corrosion rate monitors subjected to pollutant transients, and of materials in simulated flue-gas desulfurization media containing trace elements.

32145 **(PB—85-157386/XAB) Emission inventory applications to Regional Acid-Deposition Modeling.** Novak, J.H. (Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab.). Jan 1985. 7p. (EPA—600/D-85/017). NTIS, PC A02/MF A01.

A comprehensive Regional Acid Deposition Model (RADM) is being developed and a simpler fast-turn-around engineering model(s) (EM) is being designed by the National Center for Atmospheric Research as part of the National Acid Precipitation Assessment Program (NAPAP). This paper describes how potential assessment applications and research questions affect those model designs and the subsequent emission inventory requirements. Finally, a recommendation is made for EPA to consolidate inventory development efforts to produce an agency emission inventory applicable to the wide spectrum of models and applications throughout EPA.

32146 **(PB—85-169605/XAB) Overview of EPA's (Environmental Protection Agency's) LIMB technology development program.** Lachapelle, D.G. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). Feb 1985. 31p. (EPA—600/D-85/042). NTIS, PC A03/MF A01.

The paper gives an overview of EPA's Limestone Injection with Multistage Burners (LIMB) program, a program for research, development, and demonstration of cost-effective emissions control technology for coal-fired boilers that can reduce both sulfur oxides (SOx) and nitrogen oxides (NOx). The LIMB concept uses low-NOx burners plus sorbent injection to control these pollutants simultaneously. LIMB technology represents a lower-cost alternative to currently available SOx control approaches such as flue-gas desulfurization, coal cleaning, and coal switching. LIMB technology is especially attractive where coal-fired boilers must be retrofitted to minimize emissions of NOx and SOx, which are major acid-rain precursors. This is due to LIMB's relative ease of retrofit to both small and large coal-fired boilers and its lower cost. LIMB performance goals are: (for retrofit) to achieve a 50-60% reduction of both SOx and NOx from uncontrolled levels; and (for new units) to achieve a 70-80% reduction of NOx and a 70-90% reduction of SOx from uncontrolled levels.

32147 (PB—85-172336/XAB) National Dioxin Study Tier 4 - combustion sources: project plan. Final report. Lillis, E.; Miles, A. (Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards; Radian Corp., Research Triangle Park, NC (USA)). Feb 1985. 75p. (EPA/450/4—84/014A). NTIS, PC A04/MF A01.

Prepared in cooperation with Radian Corp., Research Triangle Park, NC; See also PB85-172344.

This report presents the Agency's plans for identifying likely sources and assessing dioxin emissions from combustion sources under Tier 4 of the National Dioxin Study. The primary objectives of Tier 4 are outlined in the report. These are to determine what source categories emit dioxin, at what concentrations and at what estimated exposure risk. The report describes the rationale used in developing the project plan, as well as alternative approaches that were considered. The report describes the information the Agency plans to collect to improve the current understanding of combustion sources which emit dioxin to the ambient air. The tasks to collect the information are outlined, including stack testing, ash sampling, and data analysis. References to other documents which describe methods and procedures are identified.

32148 (UCRL—15475-Suppl.1) Atmospheric boundary layer testing: experimental measurements of heavier-than-air gas dispersion in an atmospheric boundary layer. 1982-1983 Equipment loan report. Supplement 1. White, B.R.; Joske, M. (California Univ., Davis (USA). Dept. of Mechanical Engineering). Nov 1983. Contract W-7405-ENG-48. 69p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85012876.

A uniform two-dimensional carbon dioxide gas dispersion in air over a two-dimensional square obstacle was studied experimentally in an atmospheric wind tunnel. The obstacle Reynolds number was about 6000 based upon the undisturbed velocity at the height of the obstacle, and the Froude number was about 1.75. The carbon dioxide was injected vertically upward from the surface at a rate of 10 percent of the freestream velocity. The injection surface area began one obstacle length upstream and extended upstream about 1 1/2 obstacle lengths. A gas concentration measurement system for carbon dioxide mixtures and air was developed for use in an atmospheric wind tunnel. Centerline steady-state concentration profiles were measured for various locations upstream and downstream of the obstacle. The experimental results were compared with the numerical solutions of Sutton (1982). The experiment measurements of concentration were lower than the predicted results of Sutton's numerical solutions, which may be attributed to the higher value of the Froude number in the experimental measurements.

32149 (UCRL—91402) Evaluation of source strength and dispersion model predictions with data from large nitrogen tetroxide field experiments. McRae, T.G. (Lawrence Livermore National Lab., CA (USA)). Apr 1985. Contract W-7405-ENG-48. 23p. (CONF-8504135—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE85011855.

From 15. international technical meeting on air pollution modeling and it's application; St. Louis, MO, USA (15 Apr 1985).

A series of large scale nitrogen tetroxide spill tests were conducted to determine the source strength characteristics and heavy-gas dispersion aspects of large N_2O_4 spills. The source strength and downwind dispersion results of two of the spills were used to evaluate several source strength and Gaussian dispersion models. It was concluded that: the internal energy heat source is a major contributor to the source strength; that source strength models need improvement; that formation of a dense HNO_3 mist may account for much of the downwind mass transport of large N_2O_4 spills and that all models evaluated underpredict downwind gas concentrations. 34 refs., 4 figs., 7 tabs.

32150 Photosynthetic response of Bragg soybean leaves adapted to different CO_2 environments. Valle, R.; Mishoe, J.W.; Campbell, W.J.; Jones, J.W.; Allen, L.H. Jr. (Univ. of Florida, Gainesville). *Crop Science;* **25**: No. 2, 333-339(Mar-Apr 1985). Contract AI01-81ER60001.

Carbon dioxide exchange rate (CER) were measured during seed fill on leaflets of soybean [Glycine max (L.) Merr. Bragg] plants grown at 330 and 660 μmol mol^{-1} CO_2 environments in outdoor growth chambers to investigate their photosynthetic response to light. During midday periods at the R5 growth stage, the plants were submitted to short-term CO_2 levels ranging from 90 to 990 μmol mol^{-1} to determine differences in leaf photosynthetic response caused by CO_2 acclimation. The data were fitted to a rectangular hyperbola of the Michaelis-Menten form in which the independent variable was radiation or CO_2. Light and CO_2 compensation points were calculated from the parameters of the model. Light response curves showed that leaflets grown and measured at 660 μmol mol^{-1} CO_2 had higher CER asymptotes, higher apparent Michaelis-Menten constants for light, higher apparent quantum yield, and lower light compensation points than leaflets adapted to and measured at 330 μmol mol^{-1} CO_2. The CER-CO_2 curve parameters also indicated higher asymptotic ceilings of CER at high CO_2 for the higher CO_2 adapted leaflets. The CO_2 compensation point was significantly lower in leaflets adapted to high CO_2 levels than those adapted to ambient CO_2, indicating a decrease in photorespiration. It was concluded that during seed fill, leaflets adapted to high CO_2 environments exhibited a capability to utilize CO_2 and radiation more efficiently at elevated CO_2 and throughout all light levels than leaflets grown at low CO_2.

32151 Design and operation of a batch-feed fluidizing bed aerosol generator for inhalation toxicity studies. Shiotsuka, R.N.; Peck, R.W. Jr.; Drew, R.T. (Brookhaven National Lab., Upton, NY). *American Industrial Hygiene Association Journal;* **46**: No. 2, 80-84(Feb 1985). (CONF-8505143—). Contract AC02-76CH00016.

From American Industrial Hygiene conference; Las Vegas, NV, USA (19 May 1985).

A fluidizing bed aerosol generator (FBG), designed for inhalation toxicity studies, was constructed and tested. A key design feature contributing to its operational stability was the partial masking of the screen supporting the bronze beads. This caused 20-80% of the bed to fluidize under normal operating conditions. The non-fluidizing areas functioned as reservoirs to feed the fluidizing areas. Using a bed volume of 1000 cc of bronze beads and 20 g of MnO_2 dust, the mass output rate ranged from 0.1 to 1.0 mg/min when operated at plenum pressures of 1.04×10^2 to 2.42×10^2 kPa (minimum fluidization pressure was approximately 82.8 kPa). During daily operation at three different output rates, the FBG produced aerosols with little change in particle size distributions or concentration when operated six hours/day for five days. Furthermore, when the FBG was operated at a fixed output rate for 15 days with two recharges of MnO_2 dust, the particle size distribution did not show any cumulative increase. Thus, long-term operation of this FBG should result in a reproducible range of concentration and particle size distribution.

32152 Comment on local source impacts at Hubbard Brook, New Hampshire. Lipfert, F.W.; Dupuis, L.R. (Brookhaven National Lab., Upton, NY). *Journal of the Air Pollution Control Association;* **35**: No. 2, 127-129(Feb 1985).

Information was presented that implied the Hubbard Brook Ecosystem Study precipitation chemistry data base may have been compromised by the presence of a small paper-making facility some 10 km to the north at Lincoln, New Hampshire. The plant operated on coal until 1969, intermittently until 1972, and then converted to oil in 1975. The article by Coffey stated the impact (of the plant) upon the site would tend to mask the effects of regional sulfur dioxide reductions. This note examines this charge. This author computed SO_2 concentration from ground level and elevated, stack level. It was concluded that this data indicated that any influences of local pollution sources on the Hubbard Brook precipitation chemistry are quite minimal, as indicated by both theoretical analysis of the source characteristics and statistical analysis of the precipitation chemistry record per se. Although there are substantial year to year variations, a large portion of the sulfate variance is explained by variations in seasonality and precipitation. The balance is due to meteorological variability and emission variations, but there is no firm statistical evidence as to which source or group of sources is influencing Hubbard Brook precipitation chemistry. This inquiry, in response to Coffey's allegation, has shown the necessity for understanding local source effects on precipitation chemistry as a prerequisite to full understanding and interpretation of monitoring data. 13 references, 1 table.

32153 **Statistical design controversy.** Evans, L.S.; Hendrey, G.R.; Thompson, K.H. (Brookhaven National Lab., Upton, NY). *Journal of the Air Pollution Control Association;* **35**: No. 2, 99-101(Feb 1985).

This article was in response to criticisms received by Evans, Hendrey, and Thompson that their article was biased because of omissions and misrepresentations. The authors contend that experimental designs having only one plot per treatment "were, from the outset, not capable of differentiating between treatment effects and field-position effects," remains valid and is supported by decades of agronomic research. Several men, Irving, Troiano, and McCune thought of the article as a review of all studies of acidic rain effects on soybeans. It was not. The article was written over the concern of the comparisons which were being made among studies which purport to evaluate effects of acid deposition on field-grown crops, and implicitly assumes that all of the studies are of equal scientific value. They are not. Only experimental approaches that are well-focused and designed with appropriate agronomic and statistical procedures should be used for credible regional and national assessments of crop inventories. 12 references.

32154 **Comparison of statistical designs and experimental protocols used to evaluate rain acidity effects on field-grown soybeans.** Evans, L.S.; Hendrey, G.R.; Thompson, K.H. (Brookhaven National Lab., Upton, NY). *Journal of the Air Pollution Control Association;* **34**: No. 11, 1107-1114(Nov 1984). Contract AC02-76CH00016.

Published results of four field experiments testing effects of acidic precipitation in field-grown soybeans have led to contradictory conclusions. This paper examines the experimental procedures and protocols of the four experiments which could have contributed to differences in both the reported crop yields and the interpretations or conclusions drawn from the experiments. The most important difference among the experiments is in their statistical designs. Two of the field layouts used only one plot per treatment, providing replication only for plants, rows or sectors within plots, but not among plots. By using real data from a highly replicated experiment it is shown that with such deficient statistical designs treatment effects cannot be separated from other microenvironmental variables peculiar to a specific plot location. The other two experiments were highly replicated. They were designed to detect differences of approximately 10% among treatment means. Type 1 error, α, was predetermined, and replication was sufficient to keep type 2 error low. This design was made possible because a preliminary experiment was available to estimate the expected components of variance. Despite differences in the procedures and protocols among the four experiments, it is primarily the quality of the experimental design which has determined their validity and relative utility for crop loss assessment. 26 references.

32155 **Commentary.** Irving, P.M. (Argonne National Lab., IL). *Journal of the Air Pollution Control Association;* **34**: No. 11, 1114-1115(Nov 1984).

Patricia Irving is defending the data that they collected concerning the effects acid rain has on soybeans. The paper by Evans et al. focused mainly on the shortcomings in other researchers' experiments, and concluded that their work was only credible. Experiment 2 which Irving conducted (in a dose-response function) was not designed for the results to be extrapolated for use beyond the limits of their experimental design. The results of Evans et al. concerning high concentrations of heavy metals which they used in Experiment 3 and 4 do not reflect those found in the rain of the rural area where soybeans were grown. Evans, while criticizing the statistical work of Irving, asserted that their errors may lead to an erroneous assertion that differences exist. However, Irving concluded that simulated acidic rain resulted in no significant yield differences in Wells soybeans compared to yields in plots exposed to nonacidic rain. Plot-to-plot variance in the Irving experiments was determined through the use of ambient rain comparison plots which were associated with each of the treated plots and was approximately 1% in 1978. Yield differences among Irving's treated plots were less than 4% for each of the two years in which the experiment was performed. The 4% difference among the treated plots is well below the 10% difference that the experiments by Evans et al. were designed to detect. Irving concluded that their work was a valuable contribution to the body of knowledge that existed six years ago regarding acid rain impacts to soybeans. Irving's current well-designed dose-response investigations will be preferable for crop assessments compared to earlier pioneering studies. 6 references, 1 table.

32156 **Climate and climate impact scenarios for Europe in a warmer world.** Lough, J.M.; Wigley, T.M.L.; Palutikof, J.P. (Univ. of East Anglia, Norwich, England). *Journal of Climate and Applied Meteorology;* **22**: 1673-1684(Oct 1983). Contract AC02-79EV10098.

Scenarios for Europe in a warmer world, such as may result from increased atmospheric carbon dioxide levels, have been constructed using the early 20th century warming as an analogue. The climate scenarios are used to construct scenarios of the impact of a global warming on energy consumption and agriculture. Cool winters alone would imply greater energy demand for space heating, but this is largely offset by warmer temperatures in spring and autumn which reduce the length of the heating season. Increased temperature variability combined with a general cooling during winter over north and northwestern Europe suggests a greater frequency of severe winters, and thus larger fluctuations in the demand for heating energy. The impact on agriculture is difficult to assess because of the complexity of crop-climate relationships and because of the importance of nonclimatic factors associated with technological change and perhaps, with enhanced photosynthesis due to increased carbon dioxide concentrations. In northern latitudes, the increase in the length of the growing season would appear to be favorable for agriculture, but warmer summers, drier springs and wetter autumns would be less favorable. A specific study was made of the effect of two different climate scenarios on crop yields in England and Wales with regression models constructed using a principal components regression technique. Most crops showed a decrease in yield for both warm-world scenarios, with largest decreases for hay yield and least effect on wheat yield. A similar regression analysis of French wine-quality showed an improvement in the quality of Bordeaux and Champagne in a warmer world. 52 references, 5 figures, 2 tables.

5003 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 29687, 29854, 30009, 30010, 30011, 30012, 30027, 30277, 30415, 30828, 32010, 32099, 32173, 32199

32157 **(EML—440) Annual report of the Surface Air Sampling Program.** Feely, H.W.; Larsen, R.; Sanderson, C. (USDOE Environmental Measurements Lab., New York). Mar 1985. 85p. NTIS, PC A05. File Number DE85012570.

Measurements of the concentrations of atmospheric radionuclides in filter samples collected for the Environmental Measurements Laboratory's Surface Air Sampling Program indicate that the tropospheric concentrations of radioactive debris from nuclear weapons tests continued to decrease during 1981 to 1983. A springtime peak in the concentrations of fission products was still discernible in the Northern Hemisphere during 1983, but in both hemispheres the concentrations were approaching the lower limits of detection of the analytical techniques that we use to measure them. During 1970 to 1981 we had included sites at the Rocky Flats Plant, Colorado within our sampling program. We were especially interested in monitoring atmospheric concentrations of plutonium that had contaminated some soil there during the 1960's. We ceased sampling at Rocky Flats in 1981 because we believed that our measurements were biased toward high levels by the location of our samplers, and no longer reflected the true levels of atmospheric contamination at the plant. During recent years, the decreasing atmospheric concentrations of debris from nuclear weapons tests have limited the accuracy and precision of the data that we report for such debris. 3 refs., 17 tabs.

32158 (JAERI-M—83-233) **Numerical simulation(I) of field tracer experiment by a system for prediction of environmental emergency dose information (SPEEDI). Field experiment with a line source.** Chino, Masamichi; Ishikawa, Hirohiko; Kakuta, Michio. (Japan Atomic Energy Research Inst., Tokyo). Jan 1984. 64p. (In Japanese). NTIS (US Sales Only), PC A04/MF A01. File Number DE85701057.

In the study about the health protection against accidental release, the development of a code-system SPEEDI and a series of field tracer experiments for the validation of calculation model in SPEEDI have been performed since 1980. This report describes about numerical simulations of field tracer experiments with a line source in 1980 and 1981 whose aim is to study the vertical diffusion in a thermally induced boundary layer (TIBL). To the simulation, WIND04/PRWDA, which are detail calculation codes in SPEEDI, were used, considering the speciality of TIBL structure and release mode of gas tracer. WIND04 calculates three-dimensional mass-consistent wind field by a variational method, and PRWDA calculates three-dimensional concentration distribution by a particle diffusion method, combined with WIND04. Calculated results show that WIND04/PRWDA can simulate complex diffusion, like that the wind distribution changes with time and that the thermally induced boundary layer exists.

32159 (JAERI-M—84-006) **Computer code for calculating a γ-external dose from a randomly distributed radioactive cloud.** Kai, Michiaki. (Japan Atomic Energy Research Inst., Tokyo). Feb 1984. 32p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. File Number DE85701058.

A computer code (CIDE) has been developed to calculate a γ-external dose from a randomly distributed radioactive cloud. Atmospheric dispersion of radioactive materials accidentally released from a nuclear reactor needs to be estimated considering time-dependent meteorological data and terrain heights. Particle-in-Cell model is useful for that purpose, but it is not easy to calculate the dose from the randomly distributed concentration by numerical integration. In this study the mean concentration in a cell evaluated by PIC model was assumed to be uniformly distributed over that cell, which was integrated as a constant concentration by a point kernel method. The dose was obtained by summing the attributable cell doses. When the concentration of plume had a Gaussian distribution, the results of CIDE code well agreed with those of GAMPLE, which was the code for calculating the dose from the Gaussian distribution. The choice of cell sizes affecting the accuracy of the calculated results was discussed.

32160 (KFK—3866) **Radon measurements in mines and dwellings.** Urban, M.; Binns, D.A.C.; Estrada, J.J. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Hauptabteilung Sicherheit). Jan 1985. 73p. (CNEN—1101). NTIS (US Sales Only), PC A03/MF A01. File Number DE85751622.

Radon measurements using a time integrating passive radon dosemeter (MAKROFOL track etch detector) have been performed in Brazilian and German mines and dwellings. The present state of the measurement technique is summarized. The results are presented together with exposure calculations and dose estimations for occupational exposure in open pit and underground mines and for the general public in houses.

32161 (MLM—3254) **Outdoor radon monitoring at Canonsburg, Pennsylvania, 1980-1983.** Rudy, C.R.; Jenkins, P.H.; Hagee, G.R.; Miles, J.C.; Yates, W.G. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 31 May 1985. Contract AC04-76DP00053. 41p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85013320.

This report summarizes the results of radon measurements from January 1980 to July 1983 near the former Vitro Manufacturing Plant located in Canonsburg, Pennsylvania. During this period, radon monitoring was performed on a continuous basis at 40 to 50 monitoring locations surrounding the site. Weekly measurements were made using Passive Environmental Radon Monitors (PERMs) at these locations. In addition, meteorological measurements were made at the same time using a weather station located at the site. The results indicate that increased radon concentrations occur downwind of the site. The maximum off-site concentration measured was 0.93 pCi/L (39-month average). The maximum on-site concentration measured was 3.0 pCi/L (11-month average). Background outdoor radon concentrations ranged from 0.20 to 0.26 pCi/L. Positive correlations were noted between radon concentrations and inverse wind speed and calm periods. A negative correlation was observed between precipitation frequency and radon concentration during weekly monitoring periods.

32162 (NIRS-RSD—60, pp 13-14) **Strontium-90 and cesium-137 in airborne dust from October, 1981 to March, 1982. Environmental and dietary materials.** Mar 1982. NTIS (US Sales Only), PC A02/MF A01. File Number DE85781034.

In Radioactivity survey data in Japan.

Airborne dust was collected by an electrostatic precipitator or a filter air sampler for every three months at a rate of more than 3000 m^3 per month. The sampling was done 1 to 1.5 meters above the ground. After radiochemical separation, the precipitates were counted for the activity using a low-background beta counter, normally for 60 min. The measuring techniques are first described; i.e. the collection and pretreatment of samples, the preparation of samples for analysis, the separation of strontium-90 and cesium-137, and the counting. The measured results are given in a table for the following locations: Fukushima, Ibaraki, Niigata, Fukui, Shizuoka, Aichi, Kyoto, Osaka, Tottori, Hiroshima, Nagasaki.

32163 (NIRS-RSD—60, pp 10-12) **Strontium-90 and cesium-137 in rain and dry fallout for WHO program from January to July, 1982. Environmental and dietary materials.** Mar 1982. NTIS (US Sales Only), PC A02/MF A01. File Number DE85781034.

In Radioactivity survey data in Japan.

Rain and dry fallout was collected monthly on a sampling tray, approximately 5000 cm^2 in area, which was filled water to a depth of 1 cm at the beginning of every month. The sample was filtered after strontium and cesium carriers were added. The sample was then passed through a cation exchange column. After radiochemical separation, the precipitates were counted for the activity using a low-background beta counter normally for 60 min. The measuring techniques are first described; i.e. the collection and pretreatment of samples, the preparation of samples for analysis, the separation of strontium-90 and cesium-137, and the counting. The measured results are given in a table for the following locations: Akita, Niigata, Ishikawa, Nagano, Osaka, Okayama, Yamaguchi, Kochi, Kagoshima, Chiba.

32164 (NIRS-RSD—60, pp 5-9) **Strontium-90 and cesium-137 in rain and dry fallout for domestic program from January to July, 1982. Environmental and dietary materials.** Mar 1982. NTIS (US Sales Only), PC A02/MF A01. File Number DE85781034.

In Radioactivity survey data in Japan.

Rain and dry fallout was collected monthly on a sampling tray, approximately 5000 cm^2 in area, which was filled with water to a depth of 1 cm at the beginning of every month. The sample was filtered after strontium and cesium carriers were added. The sample was then passed through a cation exchange column. After radiochemical separation, the precipitates were counted for the activity using a low-background beta counter, normally for 60 min. The measuring techniques are first described; i.e. the collection and pretreatment of samples, the preparation of samples for analysis, the separation of strontium-90 and cesium-137, and the counting. The measured results are given in a table for the following locations: Hokkaido, Aomori, Miyagi, Yamagata, Fukushima, Ibaraki, Tokyo, Kanagawa, Fukui, Shizuoka, Aichi, Kyoto, Hyogo, Wakayama, Tottori, Shimane, Hiroshima, Ehime, Fukuoka, Saga, Nagasaki, Okinawa.

32165 **(SSI-A—84-01) Measuring stations for gamma radiation. Results 1983.** Kjelle, P.E. (Statens Straalskyddsinstitut, Stockholm (Sweden)). Jan 1984. 22p. (In Swedish). NTIS (US Sales Only), PC A02/MF A01. File Number DE85701237.

The average values of gamma radiation as measured at five monitoring stations distributed in Sweden are presented for 1983. The results show some variation with snowcover in winter.

32166 **Radon entry into houses having a crawl space.** Nazaroff, W.W.; Doyle, S.M. (Lawrence Berkeley Lab., CA). *Health Physics;* **48**: No. 3, 265-281(Mar 1985).

The transport of ^{222}Rn from soil, through a vented crawl space, and into the living space of single-family residences was studied. Two houses were monitored in detail for periods of 5 and 7 weeks. The data suggest that, of the Rn released into the crawl space from the soil beneath the house, a significant fraction, perhaps 50% or more, enters the living space. The effect of 3 meteorological parameters - wind speed, indoor-outdoor temperature difference, and rate of barometric pressure change - on Rn concentration and entry rate were examined. In 1 of the houses a higher temperature difference corresponded to a higher indoor concentration, suggesting that the increased infiltration rate is more than compensated by an increase in the Rn entry rate. On the other hand, a high wind speed tended to reduce the indoor concentration, presumably by increasing both cross-ventilation of the crawl space and the infiltration rate of the living space. Results suggest that Rn transport into the crawl space of at least 1 of the houses occurred by pressure-driven flow, rather than solely by molecular diffusion. A third house was studied using a tracer gas injected into the crawl space at a controlled rate. The fraction of air leaving the crawl space that entered the living space ranged from 0.3 to 0.65. By sealing leaks in the floor of this house, the average infiltration rate was reduced by 25%, but the indoor concentration of the tracer gas remained constant.

32167 **Thermophoretic separation of aerosol particles from a sampled gas stream.** Postma, A.K. (to Dept. of Energy). US Patent Application 6-648,197. 7 Sep 1984. 10p. Contract AC06-76FF02170.

This disclosure relates to separation of aerosol particles from gas samples withdrawn from within a contained atmosphere, such as containment vessels for nuclear reactors or other process equipment where remote gaseous sampling is required. It is specifically directed to separation of dense aerosols including particles of any size and at high mass loadings and high corrosivity. The United States Government has rights in this invention pursuant to Contract DE-AC06-76FF02170 between the US Department of Energy and Westinghouse Electric Corporation.

5005 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 32120

5006 Regulations

REFER ALSO TO CITATION(S) 31119, 32125, 32128, 32201

32168 (DOE/ER/10231—T1, pp 87-108) **Energy supply and demand implications of CO_2.** Perry, A.M.; Fulkerson, W. (Oak Ridge National Lab., TN). 1984. NTIS, PC A07/MF A01. File Number DE85004706. Contract W-7405-ENG-26.

In Focus: energy issues for the eighties.

The concentration of atmospheric carbon dioxide (CO_2) has increased from 315 to 341 parts per million (ppm), about 8%, during the past 24 years because of the burning of fossil fuels and a progressive reduction in the mass of organic material as forests were cleared. About 59% of the emitted CO_2 has remained in the atmosphere, with the balance presumably absorbed in the oceans or by plants. The temperature changes because of this increased concentration will benefit some areas and damage others, although there is no general agreement on what constitutes an acceptable temperature increase. The authors review calculations on the effects of limiting CO_2 and conclude that 500 to 800 ppm should be the limit, which allows time for policy decisions. 20 references, 11 figures.

32169 **(STATSKONTORET—1984-21) Cadmium regulation - effects and costs.** (Statskontoret, Stockholm (Sweden)). Mar 1984. 46p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. File Number DE85750859.

The Swedish government prohibited 1979 certain use of cadmium. The regulation affects cadmium contents in some products and cadmium emission from municipal waste burning. Cadmium in fertilizers is not affected by the regulation, nor is industrial emissions. The effects of the Swedish cadmium regulation are considered so insignificant that they are not in proportion to the costs. The regulation affects maximally 1/10 of the yearly cadmium emissions of 10 tons in Sweden. The total yearly cadmium downfill is 20-40 tons. Cadmium content in arable land is reduced less than 1 percent. Control of cadmium contents in products is limited. Many companies are still importing products containing cadmium.

51 ENVIRONMENTAL SCIENCES, TERRESTRIAL

5101 Basic Studies

REFER ALSO TO CITATION(S) 32293

32170 (NAC-AR—84-01, pp 237) **Report of the Van de Graaff Group: NUCOR Isotope Unit. Fynbos density measurements.** Bain, C.A.R.; Hanekom, J.; Botha, F. (Department of Forestry). 1984. NTIS (US Sales Only), PC A14/MF A01. File Number DE85780939.

Short note.

In Annual report June 1984. [Council for Scientific and Industrial Research, Faure (South Africa). National Accelerator Center].

5102 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 29676, 29677, 29678, 29679, 29680, 29681, 29682, 29683, 29929, 30828, 31366, 31367, 32138, 32177, 32187

32171 **(NRCN—515) Estimation of the figures of merit of Mercuric-Cadmium-Telluride detectors.** Burshtein, Z. (Israel Atomic Energy Commission, Beersheba. Nuclear Research Center-Negev). May 1983. 25p. (In Hebrew). NTIS (US Sales Only), PC A02/MF A01. File Number DE85701506.

A recipe is described for the calculation of the figures of merit of a photoconductive mercuric-cadmium-telluride detector in the far infrared (8-14 μm), on the basis of the basic physical properties of the crystalline material: the molar composition, the conductivity type, the carrier mobility and the carrier density. It is also specified how to plan the detector to obtain maximal detectivity and responsivity values for a given material.

32172 **(PNL—5501) Organic solvent alteration of hydraulic properties of sedimentary rocks of low permeability: a review.** Sklarew, D.S. (Pacific Northwest Labs., Richland, WA (USA)). May 1985. Contract AC06-76RL01830. 27p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85012537.

A review of the current literature on hydrophysical interactions of organic solutes with sedimentary rocks of low permeability is presented. The motivation was the premise that low permeability rocks may act as secondary (aquifer) barriers for the containment of hazardous organic wastes, thus preventing these wastes from contaminating the groundwater. However, this premise may be incorrect if organic wastes can affect the hydraulic conductivity of these rocks. The results indicate that very little work has been done concerning interactions of organics with consolidated subsurface materials. Available information on three related topics was summarized: the effect of organic compounds on the hydrophysical properties of clays, case studies concerning the interactions of organic compounds with clays and sedimentary rocks, and the effect of shales on inorganic transport. These studies give an indication of some research areas that need to be explored with regard to the effect of organic compounds on the hydrophysical properties of sedimentary rocks; these research needs are briefly summarized. 42 refs.

5103 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 29687, 29929, 29995, 30002, 30011, 30024, 30025, 30028, 30828, 32011, 32199, 32305, 32318

32173 **(FNAL—85/32) Site environmental report for calendar year 1984.** Baker, S.I. (Fermi National Accelerator Lab., Batavia, IL (USA)). 1 May 1985. Contract AC02-76CH03000. 83p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85012743.

During CY-1984 there were no abnormal occurrences which had an impact on the facility and its operation. In CY-1984 8.3 km^2 (2045 acres) were sprayed with 2,4-D for controlling noxious weeds. In the past as much as 10 km^2 (2500 acres) were sprayed with 2,4-D. This year no 2,4-D was used in residential areas as was necessary last year. The maximum potential radiation exposure at the site boundary during CY-1984 (fence line assuming 24 hr/day occupancy) was only 0.8 mrem compared to 0.04 mrem last year and to an average exposure of 3 mrem during conventional magnet operations from 1978 to 1982. The dose of 0.8 mrem would correspond to 0.16% of the standard of 500 mrem for an individual who is not a radiation worker (Section 5). The maximum individual potential exposure to the general population would be essentially the same because the decrease in dose rate is small between the site boundary and the location of that individual. The total potential radiation exposure to the general off-site population from Fermilab operations during CY-1984 was 4.5 person-rem compared to less than 0.1 person-rem last year when the superconducting ring was being commissioned. The primary source of potential exposure was penetrating radiation from muons this year. All exposure was from external radiation, as was the case in the past. Thus, the 50 year dose commitment from operations in 1984 is expected to be the same as the exposure received in 1984. No airborne radioactivity was released across the site boundary in CY-1984 during accelerator operations because the Neutrino Area primary beam line was not receiving protons. No tritiated water was evaporated as a means of disposal in CY-1984. The off-site release of tritium in surface water totaled approximately 150 mCi, about 23% of last year's release.

32174 **(INIS-mf—9310) Basic topical problems on health hazards from ionizing radiation. Final report.** Jacobi, W.; Paretzke, H.G.; Merkle, W.; Lechle, M.; Matthies, M.; Messerer, P.; Schindel, F.; Wirth, E.; Eisfeld, K. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Inst. fuer Strahlenschutz). [1985]. 225p. (In German). NTIS (US Sales Only), PC A10/MF A01. File Number DE85780933.

In the framework of this research contract, a number of important questions have been considered which have been of basic interest in radiological protection against low doses of ionizing radiation. In particular, research concentrated on the various statistical concepts for the evaluation of epidemiological data for the purpose of radiation risk analysis, derivation of dose-time-effect-relationships for certain somatic effects, time dependence of selected dose-conversion factors, radiation hazards of carbon-14, tritium, and of radon daughter products. The essential results have been reported in separate publications, and therefore will only be shortly summarized here. (orig./HP).

32175 **(INIS-mf—9574) Radionuclides in terrestrial ecosystems. Radioecological computer-based bibliography.** Howard, B.J.; Kennedy, V.H.; Nelson, A. (Department of the Environment, London (UK)). Jun 1983. 170p. NTIS (US Sales Only), PC A08/MF A01. File Number DE85701231.

A bibliographical database has been developed to provide quick access to research and background literature in the field of radioecology. This is a development of an earlier database described by Nelson (Bocock 1981). ITE's particular fields of interest have led to a subject bias in the bibliography towards studies in Cumbria, especially those concerned with radionuclides originating from the reprocessing plant at Sellafield, and towards ecological research studies that are complementary to radionuclide studies. Other subjects covered, include the chemistry of radionuclides, budgets and transfers within ecosystems and techniques for the analysis of environmental samples. ITE's research objectives have led to the establishment of a specialized database which is intended to complement rather than compete with the large international databases made available by suppliers such as IRS-DIALTECH or DIALOG. Currently the database holds about 1900 references which are stored on a 2 1/2 megabyte hard disk on a Digital PDP11/34 computer operating under a time shared system. The references follow a standard format.

32176 **(NRL—1983/6) Annual terrestrial gamma radiation dose to the population of the urban Christchurch area.** Chapman, R.H. (National Radiation Lab., Christchurch (New Zealand)). 1983. 19p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85701477.

Natural terrestrial gamma radiation dose rates were measured with a high pressure ionization chamber at 70 indoor (195 site measurements) and 58 outdoor locations in the metropolitan Christchurch area. Based on these site measurements, the average gonad dose rate to the population from natural terrestrial gamma radiation was estimated to be 273+-56 microgray per annum.

32177 **(SAND—85-0551) 1984 Environmental summary: Sandia National Laboratories Tonopah Test Range, Tonopah, Nevada.** Millard, G.C.; Lathrop, L.W. (Sandia National Labs., Albuquerque, NM (USA)). Apr 1985. Contract AC04-76DP00789. 8p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85011145.

The Tonopah Test Range is located about 160 air miles northwest of Las Vegas, Nevada, and covers 525 square miles within the Nellis Air Force Base Bombing and Gunnery Range. The range is used for various DOE tests involving high and low altitude projectiles. Operations that affect the environment are mainly road construction, preparation of instrumentation sites, and disturbance of the terrain from projectile impacts. Monitoring of the test range is done annually by the US Environmental Protection Agency to supplement Sandia's monitoring effort. Monitoring results indicate that test range operations do not adversely affect the offsite environment or the public. 7 refs.

32178 **(SKBF-KBS-TR—83-34) Radionuclide diffusion and mobilities in compacted bentonite.** Torstenfelt, B.; Allard, B.; Andersson, K.; Kipatsi, H.; Eliasson, L.; Olofsson, U.; Persson, H. (Swedish Nuclear Fuel Supply Co., Stockholm. Div. KBS). Dec 1983. 30p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85701274.

Transport rates of the fission products strontium, technetium, iodide and cesium as well as the actinides thorium, protactinium, uranium, neptunium, plutonium and americium in compacted bentonite have been studied. A sodium bentonite, Wyoming Bentonite MX-80, was used in all experiments, in a few cases mixed with 1 per cent $Fe_3(PO_4)_2$, 1 per cent Pb0 or 0.5 per cent Fe(S), or 1 per cent of one of the minerals apatite, pyrite, chalcopyrite/pyrite, cinnabar or olivine. The aqueous phase was a synthetic groundwater representative of Swedish deep granitic groundwaters, preequilibrated with the clay. Uranium and americium migration was also studied with high carbonate content and 10 mg/1 humic acid, respectively, added to the water. The diffusivity was measured in compacted clay (density 2 times 10^3 kg/m^3) and calculated from concentration profiles. The diffusivities for the fission products were of the order of 10^{-12} m^2/s under oxidizing conditions and about one order of magnitude lower for technetium under reducing conditions (Fe(s) in the clay). Penta- and hexavalent actinides had diffusivities around 10^{-13} m^2/s and tri- and tetravalent actinides around 10^{-15} m^2/s. The influence of the additives to the clay or the water was minor in the uranium systems except when Fe(s) was added to the clay, which decreased the transport rate by a factor of 10.

32179 **Determining the number and size of soil aliquots for assessing particulate contaminant concentrations.** Gilbert, R.O.; Doctor, P.G. (Pacific Northwest Lab., Richland, WA). *Journal of Environmental Quality;* **14**: No. 2, 286-292(Apr-Jun 1985). Contract AC06-76RL01830.

In this paper the planning of radionuclide and other environmental contaminant studies is discussed. This discussion is based on a study of the relationship between soil aliquot size and the variability between aliquot ^{241}Am concentrations. The study consisted of drawing multiple soil aliquots of size 1, 10, 25, 50, and 100 g from a large composite soil sample collected at a nuclear weapons testing area on the Nevada Test site. These aliquots were then analyzed for ^{241}Am. The between aliquot standard deviation (s) of the data increased ninefold as aliquot size declined from 100 to 1 g. This implies that about 70 times as many 1-g aliquots than 100-g aliquots would be needed to achieve the same precision in the estimated mean of a single field sample. The data suggest a linear relationship between logarithms of s and aliquot weight (w). This relationship is used to determine the optimum w and number, n, of aliquots per field sample that should be used. These results are also extended to a second contaminant (/sup 239, 240/Pu in this case) that is in a ratio relationship to ^{241}Am. Also, an approach is given for obtaining optimum numbers of field samples and number of aliquots per field sample to minimize either total sampling and analysis costs or the variance of the estimated mean. The aliquot data from the ^{241}Am study indicate increasing median and geometric mean concentrations with increasing aliquot size. This happens because as aliquot weight increases there is a decrease in skewness of the frequency distribution of aliquot concentrations. Since the arithmetic mean is not affected (on the average) by a change in skewness, it may be preferred to the geometric mean or median when comparing results from studies that have used different aliquot sizes.

5105 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 29915, 29990, 30014

32180 **(EGG—1183-2356-Pts.1-2) Status of endangered and threatened plant species on Nevada Test Site: a survey, Parts 1 and 2. Appendix C: collection records for the taxa considered.** Cochrane, S. (EG and G, Inc., Goleta, CA (USA). Santa Barbara Operations). Mar 1979. Contract AC08-76NV01183. 100p. NTIS, PC A05/MF A01; GPO Dep. File Number DE85011766.

This inventory of herbarium collections is a compilation of information on plant specimens seen by the author in major herbaria of California, Nevada, and Utah, and in the Missouri Botanical Garden and the US National Herbarium. Other information garnered from individuals and from records listed in Beatley, 1977a, b, and c is also included. The report is meant to provide more precise species locations and distribution data to assist those making decisions about species status, so that protective measures can be taken when deemed necessary.

5106 Regulations

REFER ALSO TO CITATION(S) 29853, 32169

52 ENVIRONMENTAL SCIENCES, AQUATIC

5201 Basic Studies

REFER ALSO TO CITATION(S) 32012

32181 **(AECL—8178) LEEM - a lake energy and evaporation model user's manual.** Barry, P.J.; Robertson, E. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Nov 1983. 94p. NTIS (US Sales Only), PC A05/MF A01. File Number DE85701224.

LEEM is a simplified one-dimensional computer model of the energy budgets of lakes. It is intended to be used operationally to estimate evaporation rates averaged over several days using synoptic meteorological data with only the initial water temperatures being specified. These may usually be taken to be 4 deg. C a few days after spring break-up. This report describes the theoretical basis of the model and the algorithms by which these are converted to computer code. The code itself is included together with an exemplary set of data cards and the corresponding output.

32182 **(GAT-S—32) Investigation of fluidized-bed biological denitrification.** Acox, T.A. (Goodyear Atomic Corp., Piketon, OH (USA)). 16 Dec 1982. Contract AC05-76OR00001. 41p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85012803.

The performance of the fluidized-bed bioreactor was modelled for denitrification using a multiple linear regression. Reasonable accuracy was obtained; however, this type of analysis did not take into account the hydraulic characteristics of the fluidized-bed. The Mulcahy and LaMotta computer program previously used to model a fluidized-bed bioreactor cannot be used in this case due to the Michaelis-Menton constant k determined in this study, which was one to two orders of magnitude lower. With some additional bioreactor study and computer program modification, this may prove to be of some benefit.

32183 **(IFIN-RB—5-1981) Method of radioactive tracer samples with ion exchange resins for spectrometric analysis with Ge(Li) detector.** Stanescu, S.P.; Farcasiu, O.M. (Institutul Central de Fizica, Bucharest (Romania)). Jul 1981. 18p. (In Romanian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85701238.

The radioactive tracers methods presently in use in hydrology are based on "in situ" low resolution gamma-ray spectrometry measurements. However sometimes the information obtained in this way is not conclusive and the need for better spectrometry systems is evident. Therefore the authors present a method for measuring in laboratory conditions samples of radioactive tracers collected "in situ" and concentrated on ion exchange resins, using low level gamma-ray spectrometry with Ge(Li) detector. The advantages of this method in comparison with the methods based on Na(Tl) detectors are also presented in the paper.

32184 (WSD-Misc—49, pp 146-149) **Use of radioactive isotopes as tracers in rivers.** Barry, B.J.; McCabe, W.J. (Department of Scientific and Industrial Research, Lower Hutt (New Zealand). Inst. of Nuclear Sciences). 1982. NTIS (US Sales Only), PC A08/MF A01. File Number DE85780944. (CONF-8111226—).

From River and estuary mixing workshop; Hamilton, New Zealand (17 Nov 1981).

The use of radioisotopes for studying mixing in rivers is discussed from a practical point of view. The unique features of the technique, its advantages and disadvantages, its sensitivity and its cost are all considered so that those interested in tracing work should be able to make at least a preliminary assessment of its potential value to them.

32185 **(WSD-Misc—49) Proceedings of the River and Estuary Mixing Workshop, Hamilton, 17-18 November 1981.** Rutherford, J.C. (ed.). (Ministry of Works and Development, Hamilton (New Zealand). Water and Soil Science Centre). 1982. 160p. (CONF-8111226—). NTIS (US Sales Only), PC A08/MF A01. File Number DE85780944.

From River and estuary mixing workshop; Hamilton, New Zealand (17 Nov 1981).

Items within the scope of EDB have been entered individually into the data base.

5202 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 29786, 31643, 31650, 32134, 32182, 32389

32186 (DOE/CH/00016—T6) Anaerobic microbial transformations in subsurface environments: project description. Francis, A.J. (Brookhaven National Lab., Upton, NY (USA)). Apr 1985. Contract AC02-76CH00016. 39p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85012789.

Both laboratory and field investigations were conducted to understand the basic biochemical processes involved in the anaerobic transformation of trace metals and selected organic compounds. Controlled laboratory experiments consist of dissolution of trace metals such as As, Cd, Cr, Hg, Mn, Ni, and Pb from model substrate. The effects of the environmental variables such as temperature, pH, O_2 tension, moisture, carbon, nitrogen and alternate electron acceptors that may accelerate or reduce biochemical processes in subsurface environments are being investigated. In concert with laboratory research, field studies in the Appalachian region consist of water leachate and soil/waste core sample collection, and physical, chemical and biological characterizations to develop an improved understanding of anaerobic microbial processes. Laboratory observations and processes will be verified and experimental designs will be modified, using information obtained under actual field conditions. The results generated from this basic scientific study will increase our understanding of the biochemical transformations of toxic substances in subsurface environments.

32187 (DOE/ER—0222) Multi-solute subsurface transport modeling for energy solid wastes: highlights FY 1984. Theis, T.L.; Kirkner, D.J.; Jennings, A.A. (Clarkson Univ., Potsdam, NY (USA); Notre Dame Univ., IN (USA)). Jan 1985. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85012788.

At the present time a general multi-solute model, FIESTA, has been developed which combines the chemical processes of ion exchange, adsorption and complex formation, and the physical factors of convection and dispersion. Present research, highlighted in this report, is aimed at incorporating solubility reactions and a general kinetic, rather than equilibrium, approach to the chemical interactions.

32188 (Juel-Spez—276) Methods of ecotoxicological evaluation of chemicals. Vol. 5. Scheele, B.; Fuehr, F.; Stuettgen, E. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Projekttraeger fuer Umweltchemikalien). Oct 1984. 269p. (In German). NTIS (US Sales Only), PC A12/MF A01. File Number DE85752000.

The following report presents the results of nine research projects being the second part of an extensive program under the title 'Methods of ecotoxicological evaluation of chemicals'. This program has been sponsored in connection with legislative activites related to the regulation of trading with chemicals since 1978 by the Dept. of Research and Technology. In all testing procedures under this program 'Reference chemicals' had been used in order to more correctly evaluate the efficiency of comparable methods as well as to compare with the known behavior of the chemicals in the environment. Seven of the testing methods presented on this volume deal with the evaluation of the toxic potential of a chemical. Two of these use calorimetric systems. Furthermore one test method refers to the anaerobic degradation of chemicals. The first part of this project is described in volume one.

32189 (LBL—6878) Survey of instrumentation used for monitoring metals in water. Quinby-Hunt, M.S. (Lawrence Berkeley Lab., CA (USA)). Jun 1978. Contract W-7405-ENG-48. 38p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85012008.

A study was conducted of instrumentation used to determine metals in water. Several of the techniques most commonly used for analysis and routine determinations of metals in water are shown in Table 1. They are atomic absorption spectroscopy, both flame and flameless, atomic emission spectroscopy using conventional flame sources and inductively-coupled plasma sources, and ultraviolet-visible absorption techniques. Other less frequently employed methods are x-ray fluorescence analysis using both photon and charged particle excitation with energy-dispersive and wavelength-dispersive spectral analysis. Also electrochemical techniques and activation analysis are studied.

32190 (PB—85-155695/XAB) Cost digest: cost summaries of selected environmental control technologies. Report for January 1981-June 1982. DeWolf, G.; Murin, P.; Jarvis, J.; Kelly, M. (Radian Corp., Austin, TX (USA)). Oct 1984. 107p. (RAD—82-203-001-47-03). NTIS, PC A06/MF A01.

The report summarizes cost data on over 20 environmental control technologies. The cost parameters presented include total capital investment, net annual operating expenses, and unit annualized costs. These cost estimates are given over an appropriate range of system capacities for six technologies in drinking water treatment (e.g., granular activated carbon), eight technologies in wastewater treatment (e.g., conventional secondary and advanced), four particulate matter control technologies (e.g., fabric filters), and six flue gas desulfurization technologies (e.g., lime/limestone scrubbing). For each technology, the report contains a short narrative summary, a block flow diagram with battery limits noted around the modules included in the cost estimate, design specifications, performance characteristics, and a discussion of major factors affecting cost. All costs are given in March 1980 dollars.

32191 (BG-Trans—6440) Method of wet oxidation treatment of waste water. Kimoto, Sanemi; Harada, Yoshiaki; Ueda, Tomonori. (British Gas Corp., London; Osaka Gas Co. Ltd. (Japan)). 26 Mar 1985. Translation of Japanese Patent Application 59-115786, 1982. 5p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85901525.

A method is claimed for treating waste water by wet oxidation. Waste water with pH 9 or higher, and a water soluble ruthenium salt or palladium salt or both are fed into a reactor containing a corrosion-resistant granular carrier so that ruthenium and/or palladium is precipitated on to the granular carrier surface. The temperature of the waste water is kept at 100 to 370°C and the pressure is maintained such that the waste water retains a liquid phase. A gas is supplied which contains oxygen in a quantity which is 1 to 1.5 times the theoretical quantity needed for decomposing the COD constituents and/or ammonia in the waste water. An alkaline substance is also added to the system so that pH of the liquid after oxidation becomes 5 to 8. Examples of corrosion-resistant granular carrier are titania, zirconia, and other ceramic materials and porous metals such as Ni, Ti, Ti-Pd alloys and high Ni alloys. Examples of water soluble ruthenium and palladium salts used as catalyst active constituent source are: $RuCl_3$, Na_2RuO_4, K_2RuO_4, $PdCl_2$, $PdSO_4$ and $Pd(NO_3)_2$. The oxygen source may be air, oxygen-enriched air, oxygen, waste gases containing oxygen and the like.

5203 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 29933, 29934, 29961, 29996, 30003, 30006, 30007, 30011, 30012, 30016, 30024, 30028, 30828, 32011, 32012, 32110, 32173, 32178, 32382, 32389, 32817

32192 (DEMO—82/14) Radioecological studies in marine environment. A study of the concentration of mixed fission products in Greek sea waters and of ^{137}Cs in fish and sea plants. Danali-Cotsaki, S.; Florou-Gazi, H. (Democritos Nuclear Research Center, Athens (Greece)). Dec 1982. 22p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85701232.

The concentrations of mixed fission products in sea water and of ^{137}Cs in fish and sea plants are different from samples collected from different sampling areas. This difference is more remarkable the year where the level of the worldwide fall-out is higher, especially with regards to M.F.P. concentrations in sea water samples. Increases or decreases of M.F.P. concentrations in sea water samples result to increases or decreases of ^{137}Cs in fish and sea plants.

32193 (DEMO—83/10G) **Isotope hydrology study of Kato Nevrokopi, Drama Dept.** Leontiadis, I.L.; Payne, B.R.; Letsios, A.; Papayanni, N.; Kakarelis, D.; Hadjiagorakis, D. (Democritos Nuclear Research Center, Athens (Greece)). Jul 1983. 47p. (In Greek). NTIS (US Sales Only), PC A03/MF A01. File Number DE85701463.

Data.

The isotopic composition of the water was used in order to define the mechanism of recharge of the high plateau of Kato Nevrokopi. The results of this study have shown that the groundwater reservoir of the high plateau is mainly fed by waters originating from the mountain Falakro and the Vathytopos stream; the local rains do not contribute significantly to the recharge of its groundwater. An underground barrier prevents the draining of the groundwater through the sinkhole resulting in a very big reservoir under the whole central and southern parts of the high plateau. The exploitation of the groundwater of this reservoir offers very probably the solution for the satisfaction of all needs of the area for irrigation water at low cost.

32194 (IAEA-TECDOC—301) **Behaviour of radium in waterways and aquifers. Final report of the Coordinated Research Programme on source, distribution, movement and deposition of radium in inland waterways and aquifers sponsored by the IAEA from 1976 to 1980.** (International Atomic Energy Agency, Vienna (Austria)). Jan 1984. 262p. NTIS (US Sales Only), PC A12/MF A01. File Number DE85701047.

The Coordinated Research Program was designed to develop systematic information on the form and movement of radium in water under a range of environmental conditions. The final report contains: a) Selection and standardization of methods for determination of radium in water; b) The distribution of soluble and insoluble radium in natural waters, affected by mining or milling operations; c) The factors affecting the leaching rate from ore heaps and tailings piles; d) The uptake of radium by biological systems, especially those which form part of man's food chain. This information being of great value to those authorities responsible for assessing the consequences of radium releases to water and to those responsible for setting discharge limits.

32195 (INS-R—317) **Non-terrestrial food source for Fiordland brachiopods. Carbon isotope evidence.** Lyon, G.L.; Richardson, J. (Department of Scientific and Industrial Research, Lower Hutt (New Zealand). Inst. of Nuclear Sciences). May 1983. 15p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85701471.

Contains appendix, "Radiocarbon study of brachiopods in Fiordland".

Carbon-13 analyses were determined for brachiopods and particulate organic matter from Fiordland waters. Brachiopod delta ^{13}C are about $^{-18}$ per mille which is significantly enriched in ^{13}C relative to the particulate matter (about -23 per mille) and different from local terrestrial matter (about -28 per mille). There is no carbon-13 evidence for non-marine food in the diet of brachiopods.

32196 (INS-R—320) **Deuterium in New Zealand rivers and streams.** Stewart, M.K.; Cox, M.A.; James, M.R.; Lyon, G.L. (Department of Scientific and Industrial Research, Lower Hutt (New Zealand). Inst. of Nuclear Sciences). Jul 1983. 42p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85701464.

Over 750 deuterium measurements on rivers and streams in New Zealand are reported. Monthly samples were collected for periods of several years from a number of representative rivers. These show irregular storm-to-storm as well as seasonal deuterium variations. The seasonal variations range from as low as 1 per mille for lake-fed rivers to 8-10 per mille for rivers with large spring snowmelt contributions. Variations in mean annual γD values are believed to reflect changes in climatic variables; the present data will be used to compare with future changes. The bulk of the data are single samples; these show a geographic variation related to the altitude, latitude and climatic character of the catchments, with the highest deuterium contents (γD = -20 per mille) occurring in the far north, and lowest contents (-80 per mille) in the inland Otago region. Regression equations derived for the γD dependence on altitude (h) and latitude (l), are $\gamma D = -0.0169\ h - 30.2$ and westerly influence. Eastern climatic zones have lower deuterium contents because of rainout effects on the axial ranges. Contours of constant.

32197 (NIRS-M—41, pp 262-270) **Recent environmental tritium levels in Japan.** Iwakura, T.; Inoue, Y.; Tanaka, K.; Kasida, Y. (National Inst. of Radiological Sciences, Chiba (Japan)). Mar 1982. NTIS (US Sales Only), PC A15/MF A01. File Number DE85781032. (CONF-811082—).

From Workshop on tritium radiobiology and health physics; Chiba, Japan (1 Oct 1981).

Data of the tritium surveillance program are summarized for the period of 1967 through 1980. Samples of surface water, tap water, coastal sea water and ground water were collected from environs of commercial nuclear power plants and nuclear facilities, and were analyzed by liquid scintillation counting. Although the results show some differences in tritium concentrations in water samples from various part of the country, there is a general tendency of the concentration in surface waters to decline as a function of time. This implies that environmental waters in Japan generally have not been influenced by the discharged effluents of the facilities or the stations with regard to tritium contamination and that the tritium content of precipitation still plays the dominant role in reflecting annual variation of tritium concentration in surface waters.

32198 (NIRS-RSD—60, pp 18) **Strontium-90 and cesium-137 in freshwater from December, 1981, to July, 1982. Environmental and dietary materials.** Mar 1982. NTIS (US Sales Only), PC A02/MF A01. File Number DE85781034.

In Radioactivity survey data in Japan.

Freshwater of 100 liters each was collected. The water, to which the carriers of strontium and cesium were added immediately after sampling, was vigorously stirred and filtered. The sample was then passed through a cation exchange column. After radiochemical separation, the precipitates were counted for the activity using a low-background beta counter, normally for 60 min. The measuring techniques are first described; i.e. the collection and pretreatment of samples, the preparation of samples for analysis, the separation of strontium-90 and cesium-137, and the counting. The measured results are given in a table for the following locations: Fukui, Nagano, Kyoto, Hiroshima, Ibaraki, Hokkaido, Akita.

32199 (NIRS-RSD—60) **Radioactivity survey data in Japan.** (National Inst. of Radiological Sciences, Chiba (Japan)). Mar 1982. 21p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85781034.

Items within the scope of EDB have been entered individually into the data base.

32200 (RI—176) **Study on radioactive contamination of the Baltic Sea in 1979-1980.** Salo, A.; Pukhakainen, M.; Saksen, R.; Tuomainen, K.; Lazarev, L.N.; Gedeonov, L.I.; Ivanova, L.M.; Orlova, T.E.; Tishkova, N.A.; Vakulovskij, S.M. (Radievyj Inst., Leningrad (USSR)). 1983. 33p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. File Number DE85701048.

The results of joint investigation of radioactivity in the Baltic Sea, provided by the Institute of Radiation Protection (Helsinki, Finland) and the Khlopin Radium Institute (Leningrad, USSR) in 1979 and 1980 are reported. The comparison of results of intercalibration of the methods for determination of ^{90}Sr and ^{137}Cs in water samples showed that the difference was about 30%. A good agreement was found on the stage of preparations activity measurements. An essential difference of concentrations of ^{90}Sr and ^{137}Cs in water of the Baltic Sea proper and its gulfs between 1979 and 1980 was not revealed. The penetration of sup(134, 137)Cs from the North Sea to the south-western part of the Baltic Sea was detected by the Institute of Experimental Meteorology (USSR) in 1980. The data on concentrations of ^{90}Sr and ^{137}Cs in fifteen rivers falling into the Baltic Sea from Finland and USSR were summarized. The concentrations of ^{90}Sr, ^{137}Cs and sup(239, 240)Pu in bottom sediments in some regions of the Baltic Sea were estimated. The data on ^{3}H and sup(239, 240)Pu concentrations in the Baltic Sea waters in the vicinity of Loviisa and Olkiluoto nuclear power stations were reported.

5205 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 29969, 29980, 30013, 30020, 30104

5206 Regulations

32201 **(PB—85-156446/XAB) Development document for effluent limitations guidelines, new source performance standards, and pretreatment standards for the inorganic chemicals manufacturing point-source category. Phase 2. Final report.** Fielding, T. (Environmental Protection Agency, Washington, DC (USA). Effluent Guidelines Div.; Frontier Technical Associates, Inc., Buffalo, NY (USA)). Aug 1984. 607p. (EPA—440/1-84/007). NTIS, PC A99/MF A01.

See also PB82-265612; Prepared in cooperation with Frontier Technical Associates, Inc., Buffalo, NY.

The Development Document describes the technical rationale for the development of regulations limiting discharges of pollutants into navigable waters and into publicly owned treatment works by existing and potential new sources that manufacture certain inorganic chemicals. The technological basis for effluent limitations guidelines based on best practicable technology, best available technology, best conventional technology, and new source performance standards and pretreatment standards for new and existing sources are described in detail.

53 ENVIRONMENTAL-SOCIAL ASPECTS OF ENERGY TECHNOLOGIES

5301 Social And Economic Studies

REFER ALSO TO CITATION(S) 30246, 30662, 30829, 31175

5302 Assessment Of Energy Technologies

REFER ALSO TO CITATION(S) 30243, 30660, 30661, 31119

32202 **(DES—74-24) Draft supplement to the environmental statement fiscal year 1975 proposed program. Facility location evaluation for Sappho service study area 75-13.** (Bonneville Power Administration, Portland, OR (USA)). 8 Mar 1974. 24p. NTIS, PC A02/MF A01. File Number DE85014192.

The proposed plan for meeting electrical requirements consists of the construction of a new substation near the town of Sappho located in Clallam County, Washington. Land requirements for the new substation would be approximately 3.6 acres and, depending upon the actual site location chosen, an access road ranging from 100 to 800 feet in length would also be required. As a result of the construction of the proposed facility, from 1.6 to 6 acres of timberland would be permanently removed from production. Disturbance of game in the immediate vicinity of the route would occur during construction, as would some soil erosion primarily during and immediately after construction, siltation in nearby streams, disturbance of nearby residents from noise and dust during construction, and some degradation of AM reception immediately adjacent to the right-of-way. 2 figs.

32203 **(DES—74-25) Draft supplement to the environmental statement fiscal year 1975 proposed program. Facility location evaluation for Ashe-Hanford 500-kV transmission line study area 74-3.** (Bonneville Power Administration, Portland, OR (USA)). 8 Mar 1974. 43p. NTIS, PC A03/MF A01. File Number DE85014197.

Proposed construction of a 17.8-mile 500-kV single-circuit line running from BPA's Ashe Substation Site near the Hanford No. 2 nuclear power plant site to the existing Hanford Switching Station. This facility would be located entirely within the Hanford Reservation of the Atomic Energy Commission north of the City of Richland in Benton County, Washington. Construction of the proposed transmission line would require a total right-of-way easement of approximately 612 acres through grassland. That area actually occupied by the tower footings would be removed from rangeland uses. Disturbance of game in the immediate vicintiy of the route will occur during construction as will some soil erosion primarily during and immediately after construction, siltation in nearby streams, distrubance of nearby residents from noise and dust during construction, and some degradation of AM reception immediately adjacent to the right-of-way. 10 figs.

32204 **(DES—74-26) Draft supplement to the environmental statement fiscal year 1975 proposed program. Facility location evaluation for San Juan Island service study area 74-7.** (Bonneville Power Administration, Portland, OR (USA)). 8 Mar 1974. 41p. NTIS, PC A03/MF A01. File Number DE85014195.

Proposed construction of a 1.7-mile 34.5-kV double-circuit transmission line crossing Decatur Island from east to west. The new line would replace 0.7 of a mile of an existing BPA 24.5-kV line and would then parallel and existing 24.5-kV line for a distance of 1.0 mile. The proposal also requires the construction of a new substation to be located on the eastern side of Lopez Island, Washington. The additional easement required for the proposed transmission line would remove about 1.1 acres of forestland from timber production diverting it to nonforest uses compatable with the transmission line right-of-way. Depending upon the actual site location the Lopez Island Substation could remove from 1 to 3.2 acres of forestland and 2 acres of pastureland from production. Disturbance of game in the immediate vicintiy of the transmission facilities will occur during construction, as will some soil erosion primarily during and immediately after construction, siltation in nearby streams, disturbance of nearby residents from noise and dust during construction, and some degradation of AM reception immediately adjacent to the right-of-way. 7 figs.

32205 **(DES—74-36) Draft supplement to the environmental statement fiscal year 1975 proposed program. Facility location supplement for Maple Valley 500-kV reinforcement study area 75-14.** (Bonneville Power Administration, Portland, OR (USA)). 1975. 77p. NTIS, PC A05/MF A01. File Number DE85014194.

The proposed plan of service consists of the construction of approximately 16 miles of double-circuit 5000kV transmission line. Of this total length 2.5 miles will require new right-of-way easement, 8.25 miles would parallel existing transmission lines, and 7.25 would occur on existing right-of-way. In addition, a new substation will also be required southwest of Snoqualmie, Washington. Construction of the proposed 16-mile transmission line would require approximately 134 acres of new right-of-way easement. About 6.5 miles of the line's length would traverse forested land resulting in the removal of about 105 acres from the production of timber. Construction of the new Snoqualmie Substation would require about 25 acres of land and depending upon the actual site selected would remove from 20 to 25 acres of forest land from production. Also expected to occur is the disturbance of game in the immediate vicinity of the facilities during construction, some soil erosion primarily during and immediately after construction, siltation in nearby streams, disturbance of nearby residents from noise and dust during construction, and some degradation of AM reception immediately adjacent to the right-of-way. 16 figs.

32206 **(DES—75-27) Draft supplement to the environmental statement fiscal year 1976 proposed program. Facility location evaluation for Hangman Creek Area service study area 76-8.** (Bonneville Power Administration, Portland, OR (USA)). 15 Apr 1975. 33p. NTIS, PC A03/MF A01. File Number DE85014198.

Proposed construction of a substation near Hangmen Creek, south of Spokane, Washington. Summary of environmental impacts and adverse environmental effects: approximately 3 acres of grass and shrubs would be removed for the proposed substation. Depending upon the final site selected, a few trees could be removed. Some siltation to Hangman Creek would occur. Other impacts would include the removal of wildlife habitat associated with the above mentioned substation site requirements. Disturbance to wildlife during construction would occur. Some erosion and sedimentation would occur along with a certian degree of visual impact. 2 figs., 2 tabs.

32207 **(DES—75-51) Draft supplement to the environmental statement fiscal year 1977 proposed program. Facility location evaluation for Hot Springs-Bell 500-kV line study area 76-6.** (Bonneville Power Administration, Portland, OR (USA)). 16 Sep 1975. 99p. NTIS, PC A05/MF A01. File Number DE85014196.

Proposed construction of between 146 and 165 miles of 500-kV transmission line between Hot Springs, Montana, and Bell Substation, immediately north of Spokane, Washington. Depending upon the final route location chosen, between approximately 146 and 165 miles of 500-kV transmission line between Hot Spring Substation and Bell Substation over parallel and new right-of-way would be required. Between 15 and 70 miles of new access road would also be required. Land use affected would include clearing from 2153 to 2503 acres of timber. Depending upon the route location chosen, between 3 and 4 acres of farmland would be removed from production and between 110 and 165 acres temporarily disrupted. Other impacts would include the removal of wildlife habitat associated with the above mentioned right-of-way requirements. Distrubance would occur. Visual impacts would result from clearing right-of-way through heavily forested areas. Noise and other disturbances to residents will occur, primarily during construction. 15 figs. 2 tabs.

5303 Environmental Impact Statements

REFER ALSO TO CITATION(S) 29787, 30658

32208 **(FES—74-50) Final environmental statement: proposed fiscal year 1975 program, Bonneville Power Administration.** (Bonneville Power Administration, Portland, OR (USA)). 23 Aug 1974. 212p. NTIS, PC A10/MF A01. File Number DE85014193.

Proposed construction of Fiscal Year 1975 New Facility additions to BPA's electric transmission system including approximately 435 miles of transmission lines; 8 new substations and related structures; maintenance of 12,373 miles of existing transmission lines including tower structures, conductors, and access roads; control of vegetation on approximately 15,300 acres of transmission line rights-of-way and 852 acres of substation property. The Fiscal Year 1975 Proposed Program would result in the diversion of approximately, 1100 acres of forested land to other land uses compatible with multiple use management; the permanent removal of all vegetative cover from 200 to 250 acres (depending upon actual access road requirements); the removal of 26 acres of cropland from production and a decrease in production on an additional 14 acres of cropland immediately around the new towers; visual impacts to 5 recreational waterways, and 10 scenic and/or potentially scenic roadways; disturbance of topsoil, temporary wind and water erosion, and a resultant increase in siltation and turbidity in 9 major waterways and numerous small and intermittent streams with consequential temporary adverse effects on fish mortality and spawning habitat; the introduction of particulates and combustion byproducts into the atmosphere during open burning of slash; introduction of herbicides into the environment; temporary reduction in wildlife habitat due to herbicides and clearing operations; audible noise during operation of construction equipment and transmission lines; increased risk of man-caused accidents; and maintenance of a high standard of living and level of productivity for the Pacific Northwest through continued availability of realiable electric service. 1 fig.

55 BIOMEDICAL SCIENCES, BASIC STUDIES

32209 **(DOE/EV/93011—T1) Institute of Laboratory Animal Resources 1983 annual report.** (National Academy of Sciences - National Research Council, Washington, DC (USA). Inst. of Laboratory Animal Resources). 1984. Contract AT01-76EV93011. 23p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85011743.

ILAR serves as a coordinating agency and a national and international resource for compiling and disseminating information on laboratory animals, promoting education, planning and conducting conferences and symposia, surveying facilities and resources, upgrading laboratory animal resources, and promoting high quality, humane care of laboratory animals in the US. This report diseases activities conducted in 1983, including committees on animal models and genetic stocks, infectious diseases of mice and rats, environmental conditions in animal rooms, and care and use of laboratory animals. (ACR)

32210 **(DOE/EV/93011—T2) Institute of Laboratory Animal Resources 1982 annual report.** (National Academy of Sciences - National Research Council, Washington, DC (USA). Inst. of Laboratory Animal Resources). 1983. Contract AT01-76EV93011. 21p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85011744.

ILAR serves as a coordinating agency and a national and international resource for compiling and disseminating information on laboratory animals, promoting education, planning and conducting conferences and symposia, surveying existing and required facilities and resources, upgrading laboratory animal resources, and promoting high-quality, humane care of laboratory animals in the United States. This report discusses activities conducted in 1982. (ACR)

5501 Behavioral Biology

32211 (NAC-AR—84-01, pp 238) **Report of the Van de Graaff Group: NUCOR Isotope Unit. Location of mole-rat food stores.** Bain, C.A.R.; Hanekom, J.; Jarvis, J.; Lovegrove, B. (Cape Town Univ. (South Africa). Dept. of Zoology). 1984. NTIS (US Sales Only), PC A14/MF A01. File Number DE85780939.

Short note.

In Annual report June 1984. [Council for Scientific and Industrial Research, Faure (South Africa). National Accelerator Center].

32212 (NAC-AR—84-01, pp 237) **Report of the Van de Graaff Group: NUCOR Isotope Unit. Autoradiographic gauges for penguin movements.** Bain, C.A.R.; Hanekom, J.; Wilson, R. (Cape Town Univ. (South Africa). Percy Fitzpatrick Inst. of African Ornithology). 1984. NTIS (US Sales Only), PC A14/MF A01. File Number DE85780939.

Short note.

In Annual report June 1984. [Council for Scientific and Industrial Research, Faure (South Africa). National Accelerator Center].

5502 Biochemistry

REFER ALSO TO CITATION(S) 30326, 31627, 32360

32213 **(CONF-8506115—1) Automated analysis of digital images generated by two-dimensional gel electrophoresis.** Mann, R.C.; Mansfield, B.K.; Selkirk, J.K. (Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 11p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85011906.

From 2. international congress of applied pattern recognition; Amsterdam, Netherlands (19 Jun 1985).

Two-dimensional gel electrophoresis is a method to separate proteins according to their molecular weights and mobilities in an electric field at a certain pH value. The presence of a radioactively or fluorescently labeled protein in a preparation is indicated by a spot that is produced on a film with the intensity of the spot indicative of the amount of protein. This article presents algorithms that accomplish automated quantitative analysis of digitized gel images. The limits of currently available analysis systems are discussed. The methods are implemented by software on a commercially available digital image processor that uses a minicomputer host. 13 refs., 4 figs., 3 tabs.

32214 (PUC-TN—20/83) **EPR studies of cooperative binding of Cu (II) to hemoglobin.** Louro, S.R.W.; Tabak, M. (Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Fisica). Jul 1983. 10p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85701466.

The investigation of the relative affinities of the two pairs of hemoglobin copper sites by monitoring the EPR spectra of the complexes formed by the reaction of copper with deoxyhemoglobin is reported. A model in which two sites are assumed to accept copper ions in a noncooperative way is not able to predict the experimental results. Thus it is conclude that the binding of these ions to hemoglobin is a cooperative phenomenon.

32215 (PUC-TN—30/83) **Location of the higher affinity copper site on human hemoglobin by the use of the spin label technique.** Tabak, M.; Louro, S.R.W. (Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Fisica). Nov 1983. 21p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85701467.

Addition of copper (II) ions to Cys β-93 maleimide spin-labelled human hemoglobin A produces a dramatic decrease in the amplitude of the spin-label ESR spectra. This effect was analyzed in the framework of Leigh's theory which permits interspin distances to be deduced from the effect of dipolar coupling on the ESR spectra and led to an estimate of 9A as the distance between the label and the higher affinity copper site. Taking into account the previous results which suggest that four nitrogen atoms coordinate with copper, and that the N terminal val β-1 and His β-2 residues are involved, the location of the higher affinity copper site is proposed to be at the β_1 β_2 interface of the hemoglobin molecule, involving the N terminal of one β subunit and the C terminal of the other.

32216 (SERI/PR—231-2619, pp 57-58) **Primary photosynthesis studies.** Seibert, M. (Solar Energy Research Institute, Golden, CO). Jan 1985. OSTI. File Number TI85002934.

In Solar Energy Research Institute Biomass Program. Quarterly technical report, first quarter FY 1985.

The project's objective is to improve the understanding of primary and secondary electron transport in various photosynthetic systems by developing new means to probe these reactions that will differentiate between the mechanisms involved. Two approaches were planned. Bacterial reaction center monolayers, transferred to solid substrates to study their optical and electromechanical properties, were to be used to reconstruct the photosynthetic electron transport apparatus independent of the biological membrane. This would allow the fabrication of better model energy conversion systems and the analysis of electron transport pathways. Also, oxygen evolution (a means of monitoring water-splitting in green plant photosynthesis) in active PS II membranes was studied to determine the mechanism of the process in these new preparations. The membranes were further characterized by fluorescence, luminescence, and spectrophotometric analysis. Biochemical and electron micrographic comparisons were also made. Studies under way will emphasize the proteins of PS II, their function, and their relationships to the structure of the PS II membrane and water splitting.

32217 (ZfI-Mitt—77, pp 84-91) **Chromatographic separation of NPN compounds as a routine method for the analytical evaluation of ^{15}N tests in man (with special reference to hepatopathies).** Hirschberg, K.; Jung, K. (Akademie der Wissenschaften der DDR, Leipzig. Zentralinstitut fuer Isotopen- und Strahlenforschung); Matkowitz, R. (Bezirkskrankenhaus Leipzig (German Democratic Republic). Chirurgische Klinik). Sep 1983. (In German). NTIS (US Sales Only), PC A14/MF A01. File Number DE85780083. (CONF-8305218—Summ.).

From Recent results of /sup 15/N tracer technique in medicine symposium; Rostock, German D.R. (29 May 1983).

In healthy test persons and in patients with hepatopathies the main metabolic non-protein nitrogen (NPN) compounds in blood serum and urine were determined chromatographically using ^{15}N-glycine as tracer.

32218 **Immunological investigation of the distribution of cytochromes related to the two terminal oxidases of Escherichia coli in other gram-negative bacteria.** Kranz, R.G.; Gennis, R.B. (Univ. of Illinois, Urbana). *Journal of Bacteriology;* **161**: No. 2, 709-713(Feb 1985). Contract AC02-80ER10682.

Monospecific antibodies were raised against the two terminal oxidase complexes of the aerobic respiratory chain of Escherichia coli. These are the cytochrome d and cytochrome o complexes. The antibodies were used to check for the occurrence of cross-reactive antigens in membrane preparations from a variety of gram-negative bacteria by rocket immunoelectrophoresis and immunoblotting techniques. With these criteria, proteins closely related to the cytochrome d complex of E. coli appeared to be widely distributed. Among the strains containing cytochrome d-related material were Serratia marcescens, Photobacterium phosphoreum, Salmonella typhimurium, Klebsiella pneumoniae, and Azotobacter vinelandii. The data suggest that the d-type terminal oxidase in many of these strains is associated in a complex with b-type and a_1-type cytochromes, as has been found to be the case in E. coli. K. pneumoniae and S. typhimurium were also shown to have material cross-reactive to the E. coli cytochrome o complex.

32219 **Isolation and characterization of an Escherichia coli mutant lacking the cytochrome o terminal oxidase.** Au, D.C.T.; Lorence, R.M.; Gennis, R.B. (Univ. of Illinois, Urbana). *Journal of Bacteriology;* **161**: No. 1, 123-127(Jan 1985). Contract AC02-80ER10682.

A respiration-deficient mutant of Escherichia coli has been isolated which is unable to grow aerobically on nonfermentable substrates such as succinate and lactate. Spectroscopic and immunological studies showed that this mutant lacks the cytochrome o terminal oxidase of the high aeration branch of the aerobic electron transport chain. This strain carries a mutation in a gene designated cyo which is cotransducible with the acrA locus. Mutations in cyo were obtained by mutagenizing a strain that was cyd and, thus, was lacking the cytochrome d terminal oxidase. Strain RG99, which carries both the cyd$^-$ and cyo$^-$ alleles, grows normally under anaerobic conditions in the presence of nitrate. Introduction of the cyd$^+$ allele into the strain restores the respiration function of the strain, indicating that the cytochrome o branch of the respiratory chain is dispensable under normal laboratory growth conditions.

32220 **Structure and synthesis of histopine, a histidine derivative produced by crown gall tumors.** Bates, H.A.; Kaushal, A.; Deng, P.N.; Sciaky, D. (State Univ. of New York, Stony Brook). *Biochemistry;* **23**: No. 14, 3287-3290(3 Jul 1984). Contract AC02-76CH00016.

Histopine, an unusual amino acid derivative of histidine isolated from crown gall tumors of sunflowers (Helianthus annus) inoculated with Agrobacterium tumefaciens strain B_6, was previously assigned the gross structure N-(1-carboxyethyl)histidine. A diastereomeric mixture containing histopine was readily prepared by reductive alkylation of (S)-histidine with pyruvic acid and sodium cyanoborohydride. The individual diastereomers were prepared by reaction of (S)-histidine with (R)- and (S)-2-bromopropionic acid. (R)-N-(1-Carboxyethyl)-(S)-histidine supports the growth of A. tumefaciens whereas (S)-N-(1-carboxyethyl)-(S)-histidine is inactive.

32221 **Secretory products of macrophages and their physiological functions.** Takemura, R.; Werb, Z. (Univ. of California, San Francisco). *American Journal of Physiology;* **246**: No. 2, C1-C9(Feb 1984).

Macrophages secrete a variety of biologically active substances into their local milieu, including proteins, lipids, nucleotide metabolites, and oxygen metabolites. To date, more than 50 substances secreted by macrophages have been reported: enzymes, enzyme inhibitors; plasma proteins such as complement components, coagulation factors, and apolipoprotein E; factors that regulate the functions of other cells such as interferon, interleukin 1, mitogens, and angiogenesis factor; and low molecular weight substances such as reactive metabolites of oxygen and derivatives of arachidonic acids. Macrophage-derived products are probably important in the local environment, and they are believed to be important in the physiological and pathological functions of macrophages in inflammation, tissue repair, lipoprotein metabolism, acute phase response, and in microbicidal, antiviral, tumoricidal, and immunoregulatory activities; however, macrophages may not be the sole source for the secretion of some of these products. The secretion of these products is intricately regulated, developmentally and environmentally.

32222 **Characterization of sheep lung lymph lipoproteins: chemical and physical properties.** Forte, T.M.; Cross, C.E.; Gunther, R.A.; Kramer, G.C. (Univ. of California, Berkeley). *Journal of Lipid Research;* **24**: 1358-1367(1983).

The authors have determined the composition and distribution of plasma and lung lymph lipoproteins from unanesthetized ewes. Cholesterol, triglyceride, and phospholipid levels in lung lymph were 45%, 50%, and 50%, respectively, of those in plasma. Lipoproteins from both lymph and plasma were separated into two major fractions: d $<$ 1.063 g/ml or LDL, and d 1.063-1.21 g/ml or HDL. HDL was the major lipoprotein species in the plasma and lymph. Gradients gel electrophoresis of HDL on 4-30% gels showed that, in lymph, HDL particles were shifted to larger sizes; in addition to a peak at 8.5 nm, which was similar to plasma HDL, there were two additional components of larger size, one at 9.2 nm and the other at 12 nm. Electron microscopy revealed that lymph HDL contained two new particles not seen in plasma: large, round particles, 13.6 nm diameter, and discoidal particles, 18.7 by 4.9 nm, long and short axis, respectively. Compositional analysis of lymph HDL revealed a relative enrichment in free cholesterol as well as an enrichment in apolipoprotein E. Lymph LDL on gradient gel electrophoresis was extremely heterogeneous. Several peaks were evident in the 23-30 nm size range (similar to plasma LDL), but a supplementary component at approximately 15-16 nm was also present. Whereas plasma LDL on electron microscopy contained only round particles 26 nm in diameter, lymph contained an additional, unusual particle which was close-packed, with square geometry, and was 15 nm in diameter. Changes in the physical and chemical properties of lung lymph lipoproteins suggest that these particles are metabolically modified.

32223 **Release of 3-methyladenine from nucleosomal DNA by a 3-methyladenine DNA glycosylase.** Price, J.A.; Heller, E.; Goldthwait, D.A. (Case Western Reserve Univ., Cleveland, OH). *Carcinogenesis (New York);* **4**: No. 2, 145-152(1983). Contract AC02-76EV02725.

Nucleosomes from chicken erythrocytes, with DNA containing an average of 144 base pairs, were alkylated with $[^3H]$methylnitrosourea. The level of alkylation of the nucleosomal DNA was 48% of that of free DNA. The histones had approximately one tenth the radioactivity of the DNA. There was no statistically significant difference between alkylation of nucleosome bases in the major vs. minor groove. When the first 50 residues of the alkylated nucleosomal DNA were examined on sequencing gels, the 7-methylguanine and 3-methyladenine (3-MeA) residues were distributed randomly. The 3-MeA DNA glycosylase I of E. coli was used to measure the release of 3-MeA groups of the nucleosomal DNA. A partially purified 3-MeA DNA glycosylase from rat liver gave similar results. The limited enzymatic release is most likely due to steric hindrance of the enzyme by the DNA-Histone interactions on the surface of the core particle. An alteration of nucleosomal conformation has been suggested as an explanation for repair of nucleosomal DNA. Two model systems have been examined. The addition of ethidium bromide to alkylated nucleosomes increased the enzymatic release of 3-MeA to ~75% and altered the electron microscopic appearance. The chemical alkylation of nucleosomes also increased the enzymatic release of 3-MeA as well as decreased the sedimentation coefficient. All of these experiments indicate a limited availability of 3-MeA residues to the glycosylase and suggest that some conformational change must occur in vivo for complete repair. 52 references, 6 figures, 4 tables.

32224 **Glycoprotein processing in mutants of HSV-1 that induce cell fusion.** Person, S.; Kousoulas, K.G.; Knowles, R.W.; Read, G.S.; Holland, T.C.; Keller, P.M.; Warner, S.C. (Pennsylvania State Univ., University Park). *Virology;* **117**: 293-306(1982).

The synthesis of viral-specified glycoproteins, and their appearance on cell surfaces, were compared for cells infected either with syncytial mutants of HSV-1 or with the parental strains from which the mutants were derived. The mutants MP and tsB5, representatives of two different viral genes that affect fusion, were employed in these studies. Cells infected with either mutant gave rise to reduce surface labeling of major viral-specified glycoproteins throughout infection relative to the parental strains. Putative glycoprotein precursors were synthesized in similar amounts throughout infection in mutant and wild-type infected cells. However, during a chase period after a pulse of labeling, fully glycosylated species of glycoproteins accumulated more slowly in mutant than in parent infected cells. The effect was clearly visible early in MP-infected cells and by 9 hr after infection for tsB5-infected cells, and increased thereafter. Apparently the decrease in appearance of glycoproteins on the cell surface of mutant-infected cells is due to a decrease in their rate of processing. 26 references, 7 figures.

32225 **Photokinetic aspects of specific hydrogen bonding in all-trans retinal at room temperature.** Das, P.K.; Hug, G.L. (Univ. of Notre Dame, IN). *Photochemistry and Photobiology;* **36**: 455-461(1982).

Room-temperature hydrogen-bonding of all-trans retinal (ATR) with 1,1,1,3,3,3,-hexafluoro-2-propanol (HFIP) in cyclohexane results in fluorescence enhancement and triplet yield quenching; these effects, as well as the associated absorption spectra changes in both ground and triplet states and the kinetics of H-bonding in the triplet state, have been studied by steady-state absorption-emission and laser flash-photolytic transient measurements. The fluorescence enhancement is predominantly controlled by the H-bonding in the ground state (static interaction) and gives a value of 440 m^{-1} for the corresponding equilibrium constant which is very similar to the value (420 M^{-1}) obtained from the analysis of absorption spectral data as a function of [HFIP]. The quantum yield of triplet occupation (theta/sub T/) of the H-bonded complex, ATR-HFIP, in cyclohexane is non-negligible and is about one-third of theta/sub T/ of free ATR. The kinetic data of H-bonding equilibration in the triplet state, observable on a nanosecond time scale, indicate that the triplet ATR is a stronger base than the ground state as far as H-bonding with HFIP is concerned. 28 references, 5 figures, 1 table.

32226 **NMR of ^{13}C enriched amino acids and peptides.** London, R.E. (Los Alamos National Lab., NM). *ACS Symposium Series;* No. 191, 119-155(1982).

Some of the characteristics of labeled systems are outlined, with particular emphasis on the relation of information content to labeling pattern. The spectroscopic characteristics of ^{13}C enriched amino acids are discussed by considering separately the three categories of isotopic labeling: 1) specific enrichment, usually of a single carbon position; 2) uniform enrichment with the labeling of each carbon statistically independent; and 3) general enrichment with the carbon labeling non-random. The conformational interpretation of scalar carbon-carbon coupling constants is presented. The relaxation characteristics of carbon 13 enriched amino acids are described under the following topics: 1) ^1H relaxation in ^{13}C molecules; 2) ^{13}C relaxation in multiply enriched systems; and 3) effects of short relaxation times on lineshapes and couplings. Biological studies with isotopically labeled amino acids and peptides in combination with NMR detection allows investigation of the intracellular properties of intact cells. The biological studies also include the interactions of peptides with membranes and proteins. 97 references, 12 figures, 4 tables.

32227 **Oxidation of biologically active reducing substances by ozone.** Menzel, D.B. (Battelle Pacific Northwest Lab., Richland, WA). *Archives of Environmental Health;* **23**: 149-153(Aug 1971).

Cysteine, reduced glutathione, thioglycolic acid, NADH and NADPH are readily oxidized by ozone. When glutathione is oxidized, the product is not reducible by the biological system of glutathione reductase and NADPH. NADH and NADPH are biologically active as coenzymes, however, after oxidation. Sulfhydryl enzymes, papain, and glyceraldehyde 3-phosphate dehydrogenase are also inactivated by ozone even in the presence of cysteine. The inactive form of the enzymes is only partially reactivated by cysteine. Other sulfhydryl reagents provide only partial protection of papain against ozone. Selenocysteine in combination with cysteine is a highly effective protector. These data suggest that ozone may act by oxidation of sulfhydryl compounds, and especially sulfhydryl enzymes, to higher oxidation states than the disulfide which is not reducible by the reductases available in cells. Seleno compounds may be important cellular protectors. 14 references, 5 tables.

5503 Cytology

32228 (CONF-8504121—2) **Three-dimensional reconstruction and data display of chromosome structure studied by electron microscope tomography.** Olins, D.E. (Tennessee Univ., Oak Ridge (USA). Graduate School of Biomedical Sciences; Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85011562.

From Computer graphics '85; Dallas, TX, USA (14 Apr 1985).

Modern transmission electron microscopes can be employed to generate useful and informative three-dimensional reconstructions of asymmetric cell structures by adapting the principles of axial tomography and utilizing the power of digital image processing. An example of this technique, called electron microscope tomography (EMT), applied to analysis of the 3-D structure of an active eukaryotic gene in situ is presented. Future improvements in the field of EMT depend upon the development of methods for visualizing, editing and interpreting the rich image information of the 3-D reconstructions. 2 refs., 5 figs.

5504 Genetics

REFER ALSO TO CITATION(S) 32314

32229 (CONF-8503125—2) **Experimental approaches for the detection of chromosomal malsegregation occurring in the germline of mammals.** Russell, L.B. (Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 43p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85011908.

From Symposium on aneuploidy: etiology and mechanisms; Washington, DC, USA (25 Mar 1985).

Existing and newly proposed methods to detect the induction of heritable aneuploidy are summarized, and their favorable and unfavorable features discussed. Among the tests involving direct chromosomal examination, that involving study of pronuclear chromosome at first cleavage is judged to be the most universally informative and reliable, provided tertiary trisomy can be ruled out. Measurement of post-midterm (fetal) death is proposed as a trisomy prescreen that can be readily combined with a dominant-lethal test. Among the genetic procedures for identifying the results of malsegregation events, direct detection of aneuploids has a number of advantages over complementation methods, in which only a fraction of the products of aneuploid gametes is detectable. Direct detection of aneuploids must, however, be restricted to sex-chromosomes, if postnatal animals are examined. A genetic marker system to detect autosomal trisomies in fetuses is proposed. An examination of experimental parameters that might maximize induction of malsegregation leads to the recommendation to include preleptotene among exposed germ-cell stages. 64 refs., 3 figs., 5 tabs.

32230 **Modes of integration of heterologous plasmid** DNA **into the chromosome of Streptococcus pneumoniae.** Pozzi, G.; Guild, W.R. (Duke Univ., Durham, NC). *Journal of Bacteriology;* **161**: No. 3, 909-912(Mar 1985). Contract AS05-76EV03941.

The authors compared the efficiencies of two different processes that can direct integration of plasmids into chromosomes of recipient cells during transformation. A donor-recipient system was constructed to allow a single donor plasmid to use either flanking homology, involving an apparent double crossover, or the insertion duplication process that has been described as due to a Campbell-like single crossover between the chromosome and a circular duplex. The latter process gave 600-fold fewer insertions that did the former, confirming expectations from prior work showing that insertion of heterologous DNA by use of flanking homology is highly efficient. It has some advantages for cloning and mapping purposes and can be exploited once it is recognized.

32231 **Nodules are induced on alfalfa roots by Agrobacterium tumefaciens and Rhizobium trifolii containing small segments of the Rhizobium meliloti nodulation region.** Hirsch, A.M.; Drake, D.; Jacobs, T.W.; Long, S.R. (Wellesley College, MA). *Journal of Bacteriology;* **161**: No. 1, 223-230(Jan 1985). Contract AT03-82ER12084.

Regions of the Rhizobium meliloti nodulation genes from the symbiotic plasmid were transferred to Agrobacterium tumefaciens and Rhizobium trifolii by conjugation. The A. tumefaciens and R. trifolii trans-conjugants were unable to elicit curling of alfalfa root hairs, but were able to induce nodule development at a low frequency. These were judged to be genuine nodules on the basis of cytological and developmental criteria. Like genuine alfalfa nodules, the nodules were initiated from divisions of the inner root cortical cells. They developed a distally positioned meristem and several peripheral vascular bundles. An endodermis separated the inner tissues of the nodule from the surrounding cortex. No infection threads were found to penetrate either root hairs or the nodule cells. Bacteria were found only in intercellular spaces. Thus, alfalfa nodules induced by A. tumefaciens and R. trifolii transconjugants carrying small nodulation clones of R. meliloti were completely devoid of intracellular bacteria. When these strains were inoculated onto white clover roots, small nodule-like protrusions developed that, when examined cytologically, were found to more closely resemble roots than nodules. Although the meristem was broadened and lacked a root cap, the protrusions had a central vascular bundle and other rootlike features. The results suggest that morphogenesis of alfalfa root nodules can be uncoupled from infection thread formation. The genes encoded in the 8.7-kilobase nodulation fragment are sufficient in A. tumefaciens or R. trifolii backgrounds for nodule morphogenesis.

32232 **Differential behavior of plasmids containing chromosomal DNA insertions of various sizes during transformation and conjugation in Haemophilus influenzae.** Balganesh, M.; Setlow, J.K. (Brookhaven National Lab., Upton, NY). *Journal of Bacteriology;* **161**: No. 1, 141-146(Jan 1985).

Plasmids with chromosomal insertions were constructed by removal of a 1.1-kilobase-pair piece from the 9.8-kilobase-pair vector plasmid pDM2 by EcoRI digestion and inserting in its place various lengths of chromosomal DNA (1.7, 3.4, and 9.0 kilobase pairs) coding for resistance to novobiocin. A fourth plasmid was constructed by insertion of the largest piece of chromosomal DNA into the SmaI site of pDM2. The plasmids without inserts were taken up poorly by competent cells and thus were considered not to contain specific DNA uptake sites. The presence of even the smallest insert of chromosomal DNA caused a large increase in transformation of Rec^+ and Rec^- strains. The frequency of plasmid establishment in Rec^+ cells by transformation increased exponentially with increasing insert size, but in Rec^- cells there was less transformation by the larger plasmids. Conjugal transfer of these plasmids was carried out with the 35-kilobase-pair mobilizing plasmid pHD147. The frequency of establishment of plasmids by this method not only was not markedly affected by the presence of the insertions, but also decreased somewhat with increase in insert size and was independent of rec-1 and rec-2 genes. Recombination between plasmid and chromosome was readily detected after transformation, but could not be detected after transconjugation even when the recipient cells were Rec^+ and made competent. These data suggested that there is a special processing of plasmid DNA that enters the competent cells in transformation that makes possible recombination of homologous regions of the plasmid with the chromosome and pairing with the chromosome that aids plasmid establishment.

32233 **Analysis of the hematopoietic effects of new dominant spotting (W) mutations of the mouse. I. Influence upon hematopoietic stem cells.** Geissler, E.N.; Russell, E.S. (Jackson Lab., Bar Harbor, ME). *Experimental Hematology (Copenhagen);* **11**: No. 6, 452-460(Jul 1983).

Mice carrying two mutants W alleles usually have severe macrocytic anemias which result from deficiencies of hematopoietic stem cells (CFUs). Anemic W^{39}/W^{39} and W^{41}/W^{41} homozygotes have deficiencies in the numbers of femoral stem cells which correspond to the severities of their anemias. The non-anemic W^{44}/W^{44} homozygote has as few stem cells as the W^{41}/W^{41} mouse. Nevertheless, bone marrow implants from W^{44}/W^{44} donors cure the anemias of W/W/sup v/ recipients while implants from anemic W^{39}/W^{39} and W^{41}/W^{41} donors do not. The peripheral hematologic differences between W^{41}/W^{41} and W^{44}/W^{44} homozygotes probably arise from qualitative differences intrinsic to their stem cells rather than from extrinsic hematopoietic factors. The hematopoietic environments of all three W homozygotes are relatively normal in that they support normal erythropoiesis when injected with congenic +/+ marrow. Even non-anemic W^{44}/W^{44} recipients are repopulated with +/+ donor red cells, indicating that W^{44}/W^{44} stem cells are at a disadvantage when completing with normal counterparts. 14 references, 6 figures, 2 tables.

32234 **Numerical methods for inferring evolutionary trees.** Felsenstein, J. (Univ. of Washington, Seattle). *Quarterly Review of Biology;* **57**: No. 4, 379-404(Dec 1982). Contract AT06-70EV71005;AM06-70RL02225.

Despite a century of evolutionary theory, only in the last few decades have clearly defined procedures for inferring phylogenies been stated. For discrete characters whose ancestral states are known, the prescriptions of Hennig are well defined, but they are applicable only when there is no incompatibility between different characters. This limitation has led to the elaboration of a number of methods for dealing with such incompatibilities. Each method has a different set of implicit assumptions concerning the biology of the characters and the information available from the data. If the methods are considered in a statistical framework as different estimators of an unknown quantity (the phylogeny), these assumptions are more clearly seen. Standard statistical approaches, such as maximum likelihood, can be used to obtain methods whose properties are known and for which one can determine the amount of uncertainty in the resulting estimates of the phylogeny. Although existing statistical models are highly oversimplified and do not reflect the complexity of evolutionary processes, it is by viewing the problem as a statistical one that we can place all these methods in a common framework, within which their behavior and assumptions can be compared. 160 references, 3 figures.

32235 **How can we infer geography and history from gene frequencies.** Felsenstein, J. (Univ. of Washington, Seattle). *Journal of Theoretical Biology;* **96**: 9-20(1982). Contract AT06-70EV71005.

In principle, patterns of migration and historical branching events can be reconstructed from gene frequency data, but we still lack most of the techniques necessary to do this. This is a fairly clearly defined problem with a variety of interesting subcases. It appears likely to raise interesting mathematical and statistical questions. The amount of data potentially available is very large. The problem is reviewed, but no new solutions are proposed. 26 references, 3 figures.

5505 Metabolism

REFER ALSO TO CITATION(S) 32217, 32354, 32355, 32361, 32375

32236 **(PEL-R—819) Use of the short-lived radioisotopes ^{11}C and ^{13}N to study nitrogen uptake and photosynthate translocation in fodder beet.** McNaughton, G.S.; Minchin, P.E.H. (Department of Scientific and Industrial Research, Lower Hutt (New Zealand). Physics and Engineering Lab.). 1983. 24p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85701472.

Following discussions at the Nitrogen Balance Workshop held at Massey University, May 1980, on the use of the 10 min half-life isotope nitrogen-13, it was decided to carry out collaborative experiments with Dr K.M. Goh from Lincoln College. These were concerned with the mechanism of the effect of sodium chloride on the uptake of nitrate and ammonium ions by beet (Beta vulgaris L) plants. In this report we firstly summarize briefly some of the relevant literature then report on the experiments carried out to November 1982. The initial experiments used nitrogen-13 to investigate, with hydroponically grown plants, the effect of sodium chloride on the uptake by roots, and the transport to leaves, of nitrogen-13 applied to the roots as nitrate or as ammonium ions. After failing to find any response to NaCl in these experiments, it was decided to determine whether there was any effect of NaCl on the transport of carbon-11 labelled photosynthates from the leaves. Production of this preliminary report is a first step to assessing the next phase, if any of this investigation.

32237 (ZfI-Mitt—77, pp 62-72) **Methodical comparison of tracers and forms of application in the determination of kinetic parameters of the whole-body protein metabolism.** Krawielitzki, K.; Schadereit, R.; Evers, B.; Bock, H.D. (Akademie der Landwirtschaftswissenschaften der DDR, Dummerstorf-Rostock. Forschungszentrum fuer Tierproduktion). Sep 1983. (In German). NTIS (US Sales Only), PC A14/MF A01. File Number DE85780083. (CONF-8305218—Summ.).

From Recent results of /sup 15/N tracer technique in medicine symposium; Rostock, German D.R. (29 May 1983).

In comparative 5-pool model studies in rats ^{15}N-glycine proved to be the most suitable ^{15}N tracer and i.v. administration the most favorable form of application.

32238 (ZfI-Mitt—77, pp 191-195) **Metabolic amino acid requirements determined by means of ^{15}N-labelled amino acids.** Muenchmeyer, R.; Bergner, H.; Simon, O.; Adam, K. (Humboldt-Universitaet, Berlin (German Democratic Republic). Sektion Tierproduktion und Veterinaermedizin). Sep 1983. (In German). NTIS (US Sales Only), PC A14/MF A01. File Number DE85780083. (CONF-8305218—Summ.).

From Recent results of /sup 15/N tracer technique in medicine symposium; Rostock, German D.R. (29 May 1983).

Short note.

32239 (ZfI-Mitt—77, pp 196-200) **Endogenous secretion into the gastro-intestinal tract of laboratory animals studied by use of ^{15}N-labelled compounds.** Simon, O.; Bergner, H.; Muenchmeyer, R.; Adam, K. (Humboldt-Universitaet, Berlin (German Democratic Republic). Sektion Tierproduktion und Veterinaermedizin). Sep 1983. (In German). NTIS (US Sales Only), PC A14/MF A01. File Number DE85780083. (CONF-8305218—Summ.).

From Recent results of /sup 15/N tracer technique in medicine symposium; Rostock, German D.R. (29 May 1983).

Monogastric animals (rats and swine) as well as ruminants were investigated as to their protein metabolism especially as to the protein synthesis rate of tissues of the gastrointestinal tract and the effect of nutritive factors.

32240 (ZfI-Mitt—77, pp 289) **Utilization of some essential and non-essential amino acids after parenteral application to rats studied by ^{15}N tracer technique.** Putziger, J.; Albert, H. (Karl-Marx-Universitaet, Leipzig (German Democratic Republic). Bereich Medizin); Czarnetzki, H.D. (Rostock Univ. (German Democratic Republic). Bereich Medizin); Jung, K.; Junghans, P. (Akademie der Wissenschaften der DDR, Leipzig. Zentralinstitut fuer Isotopen- und Strahlenforschung). Sep 1983. (In German). NTIS (US Sales Only), PC A14/MF A01. File Number DE85780083. (CONF-8305218—Summ.).

From Recent results of /sup 15/N tracer technique in medicine symposium; Rostock, German D.R. (29 May 1983).

Short note.

32241 (ZfI-Mitt—77, pp 290-308) **^{15}N study of myocardial ammonia metabolism.** Pisarenko, O.I.; Studneva, I.M.; Smirnov, V.N. (Kardiologisches Forschungszentrum Moscow (USSR). Inst. fuer experimentelle Kardiologie). Sep 1983. NTIS (US Sales Only), PC A14/MF A01. File Number DE85780083. (CONF-8305218—Summ.).

From Recent results of /sup 15/N tracer technique in medicine symposium; Rostock, German D.R. (29 May 1983).

Ammonia metabolism was studied in isolated hearts of rats with and without myocardial infarction using ^{15}N tracer technique.

32242 (ZfI-Mitt—77, pp 49-61) **^{15}N studies of the glycine-N metabolism in man.** Faust, H. (Akademie der Wissenschaften der DDR, Leipzig. Zentralinstitut fuer Isotopen- und Strahlenforschung); Czarnetzki, H.D. (Rostock Univ. (German Democratic Republic). Bereich Medizin); Hartig, W. (Bezirkskrankenhaus Leipzig (German Democratic Republic). Chirurgische Klinik). Sep 1983. (In German). NTIS (US Sales Only), PC A14/MF A01. File Number DE85780083. (CONF-8305218—Summ.).

From Recent results of /sup 15/N tracer technique in medicine symposium; Rostock, German D.R. (29 May 1983).

The whole-body glycine-N metabolism of a 23 years old healthy man was studied in a 10-pool model experiment by ^{15}N-glycine multiple pulse technique.

32243 (ZfI-Mitt—77, pp 73-77) **Importance of ^{15}N-labelled yeast protein as tracer.** Wutzke, K.; Heine, W.; Drescher, U.; Richter, I.; Plath, C. (Rostock Univ. (German Democratic Republic). Bereich Medizin). Sep 1983. (In German). NTIS (US Sales Only), PC A14/MF A01. File Number DE85780083. (CONF-8305218—Summ.).

From Recent results of /sup 15/N tracer technique in medicine symposium; Rostock, German D.R. (29 May 1983).

In 5 infants various parameters of the nitrogen metabolism were comparatively investigated by means of different ^{15}N-labelled tracers such as glycine, a mixture of 10 amino acids, hen's egg white, yeast as well as highly enriched yeast protein. The ^{15}N-labelled yeast protein proved to be a real alternative to ^{15}N-glycine as tracer.

32244 (ZfI-Mitt—77, pp 98-115) **Possibilities and problems in mathematical interpretation of data in tracer kinetics.** Junghans, P.; Wagner, B.; Nickel, A. (Akademie der Wissenschaften der DDR, Leipzig. Zentralinstitut fuer Isotopen- und Strahlenforschung); Matkowitz, R. (Bezirkskrankenhaus Leipzig (German Democratic Republic). Chirurgische Klinik). Sep 1983. (In German). NTIS (US Sales Only), PC A14/MF A01. File Number DE85780083. (CONF-8305218—Summ.).

From Recent results of /sup 15/N tracer technique in medicine symposium; Rostock, German D.R. (29 May 1983).

In healthy persons and patients suffering from a liver disease kinetic studies with ^{15}N and ^{131}I tracers were performed. Mathematical models of nitrogen and protein metabolisms were elaborated.

32245 (ZfI-Mitt—77, pp 116-120) **Evaluation program of ^{15}N tracer data.** Toewe, J.; Richter, I.; Plath, C.; Heine, W.; Wutzke, K. (Rostock Univ. (German Democratic Republic). Bereich Medizin). Sep 1983. (In German). NTIS (US Sales Only), PC A14/MF A01. File Number DE85780083. (CONF-8305218—Summ.).

From Recent results of /sup 15/N tracer technique in medicine symposium; Rostock, German D.R. (29 May 1983).

A program for the evaluation of ^{15}N tracer data of the human nitrogen metabolism by means of a miniature computer is described.

32246 (ZfI-Mitt—77, pp 121-129) **Methodical aspects in studying the plasma protein turnover using ^{15}N.** Bornhak, H.; Junghans, P.; Matkowitz, R. (Akademie der Wissenschaften der DDR, Leipzig. Zentralinstitut fuer Isotopen- und Strahlenforschung). Sep 1983. (In German). NTIS (US Sales Only), PC A14/MF A01. File Number DE85780083. (CONF-8305218—Summ.).

From Recent results of /sup 15/N tracer technique in medicine symposium; Rostock, German D.R. (29 May 1983).

In healthy test persons and patients with liver and gallbladder disease, respectively, comparative studies on plasma protein turnover were performed by means of ^{15}N, ^{131}I and /sup 99m/Tc and evaluated by pool models.

32247 (ZfI-Mitt—77, pp 130-139) **Protein turnover in children studied using ^{15}N.** Pencharz, P.B. (Toronto Univ., Ontario (Canada)). Sep 1983. NTIS (US Sales Only), PC A14/MF A01. File Number DE85780083. (CONF-8305218—Summ.).

From Recent results of /sup 15/N tracer technique in medicine symposium; Rostock, German D.R. (29 May 1983).

In 12 neonates the effect of the route of feeding on protein turnover rates was studied, and in 8 children suffering from cystic fibrosis the effect of nutritional rehabilitation on the protein metabolism was examined.

32248 (ZfI-Mitt—77, pp 140-147) **Protein turnover rates in aggressive metabolism.** Hartig, W.; Matkowitz, R.; Slowig, M.; Boerner, P.; Ritter, R. (Bezirkskrankenhaus Leipzig (German Democratic Republic). Chirurgische Klinik); Czarnetzki, H.D. (Rostock Univ. (German Democratic Republic). Bereich Medizin); Junghans, H.; Faust, H. (Akademie der Wissenschaften der DDR, Leipzig. Zentralinstitut fuer Isotopen- und Strahlenforschung). Sep 1983. (In German). NTIS (US Sales Only), PC A14/MF A01. File Number DE85780083. (CONF-8305218—Summ.).

From Recent results of /sup 15/N tracer technique in medicine symposium; Rostock, German D.R. (29 May 1983).

In healthy test persons and patients after surgical stress the aggressive protein metabolism was studied comparatively by means of ^{15}N-glycine.

32249 (ZfI-Mitt—77, pp 167-173) **Application of ^{15}N tracer technique in protein metabolism studies following surgical treatment of the stomach.** Czarnetzki, H.D. (Rostock Univ. (German Democratic Republic). Bereich Medizin); Hartig, W. (Bezirkskrankenhaus Leipzig (German Democratic Republic). Chirurgische Klinik); Faust, H. (Akademie der Wissenschaften der DDR, Leipzig. Zentralinstitut fuer Isotopen- und Strahlenforschung). Sep 1983. (In German). NTIS (US Sales Only), PC A14/MF A01. File Number DE85780083. (CONF-8305218—Summ.).

From Recent results of /sup 15/N tracer technique in medicine symposium; Rostock, German D.R. (29 May 1983).

Significant changes of amino acid absorption kinetics in gastrectomized patients compared to healthy test persons were evidenced by means of ^{15}N tracers. Thus clearer insights into the intermediary N metabolism were gained being of some value for diagnostics and therapy.

32250 (ZfI-Mitt—77, pp 174-181) **Intermediary protein metabolism in premature infants fed on human milk and the infant formula Ki-Na, resp.** Plath, C.; Heine, W.; Richter, I.; Wutzke, K.; Toewe, J. (Rostock Univ. (German Democratic Republic). Bereich Medizin). Sep 1983. (In German). NTIS (US Sales Only), PC A14/MF A01. File Number DE85780083. (CONF-8305218—Summ.).

From Recent results of /sup 15/N tracer technique in medicine symposium; Rostock, German D.R. (29 May 1983).

In premature infants fed on mother's milk and infant formula Ki-Na, resp., comparative studies on synthesis, catabolism and turnover of proteins as well as on the non-protein N pool were performed by compartment analysis using an open 3-pool model and pulse labelling with ^{15}N-glycine.

32251 (ZfI-Mitt—77, pp 182-190) **^{15}N analysis in intestinal metabolism of urea and ammonia.** Stolpe, H.J.; Heine, W.; Wutzke, K.; Tiess, M. (Rostock Univ. (German Democratic Republic). Bereich Medizin). Sep 1983. (In German). NTIS (US Sales Only), PC A14/MF A01. File Number DE85780083. (CONF-8305218—Summ.).

From Recent results of /sup 15/N tracer technique in medicine symposium; Rostock, German D.R. (29 May 1983).

The qualitative and quantitative value of urea and NH_4Cl as substrates of the protein metabolism of 6 bacterial species belonging to the human intestinal flora was investigated in vitro and in vivo and the possible resorption of urea and ammonia in the rectum of the infant was examined.

32252 (ZfI-Mitt—77, pp 201-205) **Tracer kinetic analysis of amino acid absorption and protein metabolism in gastrectomized patients.** Walter, F.; Adler, K. (Karl-Marx-Universitaet, Leipzig (German Democratic Republic). Bereich Medizin); Czarnetzki, H.D. (Rostock Univ. (German Democratic Republic). Bereich Medizin); Junghans, P. (Akademie der Wissenschaften der DDR, Leipzig. Zentralinstitut fuer Isotopen- und Strahlenforschung). Sep 1983. (In German). NTIS (US Sales Only), PC A14/MF A01. File Number DE85780083. (CONF-8305218—Summ.).

From Recent results of /sup 15/N tracer technique in medicine symposium; Rostock, German D.R. (29 May 1983).

In 9 gastrectomized patients compared to 6 healthy persons total protein biosynthesis and cumulative ^{15}N elimination were determined by ^{15}N tracer technique.

32253 (ZfI-Mitt—77, pp 206-218) **Evaluation of the protein metabolism during hepatic coma evidenced by ^{15}N tracer data.** Matkowitz, R.; Hartig, W. (Bezirkskrankenhaus Leipzig (German Democratic Republic). Chirurgische Klinik); Junghans, P.; Jung, K.; Hirschberg, K.; Bornhak, H. (Akademie der Wissenschaften der DDR, Leipzig. Zentralinstitut fuer Isotopen- und Strahlenforschung). Sep 1983. (In German). NTIS (US Sales Only), PC A14/MF A01. File Number DE85780083. (CONF-8305218—Summ.).

From Recent results of /sup 15/N tracer technique in medicine symposium; Rostock, German D.R. (29 May 1983).

In patients in coma hepaticum as well as in pigs with experimental hepatic coma the protein metabolism was studied under conditions of parenteral application of an amino acid diet using ^{15}N-glycine as tracer.

32254 (ZfI-Mitt—77, pp 247-253) **Studies on the influence of the thyroid activity on the nitrogen balance using ^{15}N-glycine.** Willgerodt, H.; Keller, E.; Teichmann, B. (Karl-Marx-Universitaet, Leipzig (German Democratic Republic). Bereich Medizin); Junghans, P.; Reinhardt, R. (Akademie der Wissenschaften der DDR, Leipzig. Zentralinstitut fuer Isotopen- und Strahlenforschung). Sep 1983. (In German). NTIS (US Sales Only), PC A14/MF A01. File Number DE85780083. (CONF-8305218—Summ.).

From Recent results of /sup 15/N tracer technique in medicine symposium; Rostock, German D.R. (29 May 1983).

In 5 children suffering from hypothyroidism the retention of nitrogen was determined during substitution therapy with synthetic thyroid hormones. The patients received a single dose of ^{15}N-glycine (13.5 mg/kg body weight). During 5-6 days the total urinary N excretion, the cumulative excretion of ^{15}N, and the protein synthesis rate were determined.

32255 (ZfI-Mitt—77, pp 260-267) **Kinetic studies on nitrogen and protein metabolism in dwarfish children using ^{15}N as tracer.** Richter, I.; Plath, C.; Heine, W.; Toewe, J.; Wutzke, K.; Mix, M. (Rostock Univ. (German Democratic Republic). Bereich Medizin). Sep 1983. (In German). NTIS (US Sales Only), PC A14/MF A01. File Number DE85780083. (CONF-8305218—Summ.).

From Recent results of /sup 15/N tracer technique in medicine symposium; Rostock, German D.R. (29 May 1983).

The N retention test with 20 mg^{15}N/kg body weight was applied to 18 children with nanism of different origin and treated with growth hormone. The parameters of renal cumulative excretion and of protein synthesis rate were determined and analyzed by a 3-pool-model.

32256 **Effects of high humidity on translocation of foliar-applied labeled compounds in plants. II. Translocation from starved leaves.** Clor, M.A.; Crafts, A.S.; Yamaguchi, S. (Univ. of California, Davis). *Plant Physiology;* **38**: 501-507(1963).

Absorption and translocation of chemicals by cotton leaves are greatly increased under conditions of high humidity. This enhanced movement consists of increased phloem transport and induced uptake into and transport via the xylem. Studies with starved and normal leaves prove that phloem transport is greatly reduced in leaves depleted of carbohydrate reserves; starvation has no effect upon the xylem transport induced by high humidity. The relation of high humidity to herbicide usage is discussed. 15 references, 6 figures.

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REFER ALSO TO CITATION(S) 31698, 31699, 31700, 31702, 31705, 31706, 31707, 32249, 32253, 32325, 32325, 32325, 32337, 32803, 32826

32257 (CONF-830504—) **Single-photon ultrashort-lived radionuclides: symposium proceedings.** Paras, P.; Thiessen, J.W. (eds.). (Center for Devices and Radiological Health, Rockville, MD (USA); USDOE Office of Energy Research, Washington, DC. Office of Health and Environmental Research). 1985. 362p. NTIS $17.00/MF A01. File Number DE83017017.

From DOE single-photon ultrashort-lived radionuclides conference; Washington, DC, USA (9 May 1983).

DOE symposium series, 57.

The purpose was to define the current role and state-of-the-art regarding the development, clinical applications, and usefulness of generator-produced single-photon ultrashort-lived radionuclides (SPUSLR's) and to predict their future impact on medicine. Special emphasis was placed on the generator production of iridium-191, gold-195, and krypton-81. This report contains expanded summaries of the included papers. (ACR)

32258 (DOE/ER/60084—T2) **Current status of the Os-191 → Ir-191m generator.** Packard, A.B.; O'Brien, G.M.; Treves, S. (Children's Hospital Corp., Boston, MA (USA)). 1985. Contract AC02-82ER60084. 20p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85008306.

The advantages of ultrashort-lived radionuclides for angiography have been well documented in recent years. Although several isotopes are potentially useful in this application (e.g., Au-195m, Ag-109m, Ir-191m), Ir-191m offers several advantages. Among these advantages are a parent isotope (Os-191) with a sufficiently long half-life (15.4 d) to allow production of a generator with a reasonable shelf-life, high photon yield (129 keV, 26%; 66 keV, 55%), and ease of production of the parent isotope (i.e., neutron irradiation of Os-190). Ir-191m has not, however, been widely used for radionuclide angiocardiography because of a less than optimal generator design and the assumption that the half-life of Ir-191m (4.96 s) was too short to permit visualization of the left ventricle in adult patients. Recently we have, however, been able to develop a generator with higher Ir-191m yield (25 to 30%/ml), lower Os-191 breakthrough ($< 5 \times 10^{-4}\%$) that is easier to assemble. In addition, the eluate of this new generator (0.001M oxalic acid/0.9% saline) does not require buffering prior to injection. We have also demonstrated that adequate studies of the left ventricle can be obtained in adults when sufficient quantities of isotope are injected. 16 refs., 2 figs., 2 tabs.

32259 (IA—1404, pp 178-180) **Radioimmunoassay for 17β-estradiol.** Freud, A.; Canfi, A.; Zafran, M. Jul 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85780940.

Published in summary form only.

In Research laboratories annual report 1983.

32260 (IA—1404, pp 180-182) **Monoclonal vs. polyclonal anti-steroid antisera in radioimmunoassay systems. Systems for testosterone, progesterone and 17β estradiol.** Canfi, A.; Zafran, M. (Israel Atomic Energy Commission, Tel Aviv); Moav, N. (Inter-Yeda, Rehovot (Israel)). Jul 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85780940.

Published in summary form only.

In Research laboratories annual report 1983.

32261 (IA—1404, pp 173-174) **Evaluation of benzo(b) selenophene glycine as a potential imaging agent for nuclear medicine.** Sadeh, T.; Weingarten, R.; Even, O.; Levi, A. (Israel Atomic Energy Commission, Tel Aviv); Guillaume, M.; Christaens, L. (Liege Univ. (Belgium)); Zoller, W. (Haifa Univ., Kiryat Tivon (Israel)). Jul 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85780940.

Published in summary form only.

In Research laboratories annual report 1983.

32262 (IA—1404, pp 175-176) **Tc-99m antimony trisulfide colloid for lymphoscintigraphy.** Weininger, J.; Trumper, J. Jul 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85780940.

Published in summary form only.

In Research laboratories annual report 1983.

32263 (IAEA-TECDOC—317) **Quality control of nuclear medicine instruments.** (International Atomic Energy Agency, Vienna (Austria)). Nov 1984. 211p. NTIS (US Sales Only), PC A10/MF A01. File Number DE85701252.

This document, which gives detailed guidance on the quality control of the various electronic instruments used for radiation detection and measurement in nuclear medicine, stems from the work of two Advisory Groups convened by the International Atomic Energy Agency (IAEA). A preliminary document, including recommended test schedules but lacking actual protocols for the tests, was drawn up by the first of these groups, meeting at the IAEA Headquarters in Vienna in 1979. A revised and extended version, incorporating recommended test protocols, was prepared by the second Group, meeting likewise in Vienna in 1982. This version is the model for the present text. The document should be of value to all nuclear medicine units, and especially to those in developing countries, in the initiation or revision of schemes for the quality control of their instruments. Its recommendations have provided the basis for instruction in two IAEA regional technical co-operation projects in the subject field, one initiated in 1981 for countries of Latin America and one initiated in 1982 for countries of Asia and the Pacific.

32264 (INIS-mf—9477, pp 77-81) **Synopsis of global and regional left ventricular ejection fraction (LV-EF). Determination methodology by nuclear cardiological methods.** Horvath, M.; Nemeth, L.; Karman, M.; Pszota, A.; Horvath, P. (Allatorvostudomanyi Egyetem, Budapest (Hungary)). 1984. NTIS (US Sales Only), PC A14/MF A01. File Number DE85780935. (CONF-8409215—Absts.).

From 6. Hungarian conference on biomedical engineering and 2. IMEKO conference on measurement in clinical medicine; Balatonfuered, Hungary (18 Sep 1984).

Published in summary form only.

32265 (INIS-mf—9477, pp 82-85) **Comparison of 201-Tl myocardial perfusion scan and 99m-TC cine-VG on IHD patients under ergometric stress and with dipyridamole infusion.** Horvath, M.; Nemeth, L.; Karman, M.; Pszota, A.; Boeszoermenyi, E. (Allatorvostudomanyi Egyetem, Budapest (Hungary)). 1984. NTIS (US Sales Only), PC A14/MF A01. File Number DE85780935. (CONF-8409215—Absts.).

From 6. Hungarian conference on biomedical engineering and 2. IMEKO conference on measurement in clinical medicine; Balatonfuered, Hungary (18 Sep 1984).

Published in summary form only.

32266 (INIS-mf—9477, pp 89-91) **133-xenon regional cardio-pulmonary examinations with radiocirculograph and with computed scintillation gamma camera, MB 9100-9101.** Erdelyi, K.; Horvath, M.; Kantor, E.; Pszota, A.; Sardy, O. (Allatorvostudomanyi Egyetem, Budapest (Hungary)). 1984. NTIS (US Sales Only), PC A14/MF A01. File Number DE85780935. (CONF-8409215—Absts.).

From 6. Hungarian conference on biomedical engineering and 2. IMEKO conference on measurement in clinical medicine; Balatonfuered, Hungary (18 Sep 1984).

Published in summary form only.

32267 (INIS-mf—9477) **Abstracts of the papers and posters of the 6th Hungarian conference on biomedical engineering and 2nd IMEKO conference on measurement in clinical medicine held at Balatonfuered, Hungary, 18-20 September 1984.** (Merestechnikai es Automatizalasi Tudomanyos Egyesuelet, Budapest (Hungary)). 1984. 321p. (CONF-8409215—Absts.). NTIS (US Sales Only), PC A14/MF A01. File Number DE85780935.

From 6. Hungarian conference on biomedical engineering and 2. IMEKO conference on measurement in clinical medicine; Balatonfuered, Hungary (18 Sep 1984).

Published in summary form only.

Items within the scope of EDB have been entered individually into the data base. (ACR)

32268 (INIS-mf—9478) **Proceedings of the 12. congress of Hungarian radiologists held at Debrecen, Hungary, 27-29 August 1984. Abstracts of papers.** (Magyar Orvostudomanyi Tarsasagok es Egyesueletek Szoevetsege, Budapest. Magyar Radiologus Tarsasag). 1984. 265p. (In several languages). (CONF-8408149—Absts.). NTIS (US Sales Only), PC A12/MF A01. File Number DE85780934.

From 12. congress of Hungarian radiologists; Debrecen, Hungary (27 Aug 1984).

This proceedings contains the titles and, in most cases, the English, German or Hungarian abstracts of 245 papers. The topics include stomach diagnosis, intestines, gynecologic tumor therapy, various tumor diagnosis and therapy, pancreas diagnosis, pediatrical radiology, radiation therapy, liver and biliary track diagnosis, kidney tumor diagnosis, angiography etc. The techniques used were mainly X-ray and isotope radiological methods but others including ultrasonic technique were also employed. (R.P.).

32269 (NAC-AR—84-01, pp 211-212) **Report of the Van de Graaff Group: nuclear analysis. The effect of verapamil on the incidence of ventricular fibrillation in relation to changes in regional left ventricular blood flow.** Muller, C.A.; Thandrayen, F.T.; Hamm, C.W.; Opie, L.H. (Cape Town Univ. (South Africa). Heart Research Unit); Peisach, M.; Pineda, C.A. (Cape Provincial Administration). 1984. NTIS (US Sales Only), PC A14/MF A01. File Number DE85780939.

Short note.

In Annual report June 1984. [Council for Scientific and Industrial Research, Faure (South Africa). National Accelerator Center].

32270 (NRL—1983/5) **Perceptibility of variations in total x-ray beam filtration as evidenced on radiographs. An exploratory study.** Williamson, B.D.P. (National Radiation Lab., Christchurch (New Zealand)). 1983. 19p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85701478.

The use of filtration in the primary x-ray beam has long been a standard procedure in controlling radiation doses to patients in diagnostic radiology, particularly surface doses. For lightly filtered beams, the addition of further filtration effectively removes softer beam components which otherwise would be absorbed within the patient. The amount and quality of radiation reaching the film is changed only slightly. Thus the first increments of filtration added to diagnostic x-ray beams require little or no change in exposure factors. With further filtration, however, the penetration of the beam increases and a greater proportion is transmitted through the patient to the film. The image contrast is reduced. Simultaneously the useful beam intensity is reduced to the extent that compensating mAs increases begin to be required to maintain constant optical density in the radiograph. When these compensatory adjustments are made it is possible to examine the relationship between total filtration and its effects on radiographic appearance, which should be seen as variations in contrast or penetration. This report is of an exploratory study of the perceptibility to radiographers of these changes in radiographic appearance caused by variations in x-ray beam filtration.

32271 (NRPB-R—164) **Development and operation of a method for the remote determination of X-ray beam parameters used in dental radiography.** Hewitt, J.M. (National Radiological Protection Board, Chilton (UK)). Jul 1984. 17p. HMSO, London, price Pound 4.00.

The method described is a part of the Dental Monitoring Service operated by the Board in the UK for the assessment of radiation protection in dental practice. This postal service, which provides a comprehensive survey of dental X-ray sets and radiographic procedures, is undertaken by means of a questionnaire, film cassettes for exposure to the X-ray set and a personal monitoring component to check operator doses. The film cassettes and the methods by which the X-ray beam parameters are obtained are described in detail. The cassettes use radiation monitoring film to realise, by means of measurements of relative transmission through selected copper filters, the extended dynamic range of exposure necessary for accurate indication of the operating kilovoltage and total beam filtration. The standard of the X-ray unit with regard to the relevant regulations and code of practice can then be assessed, and, from the values of radiation dose determined for chosen exposure times, exposure settings for optimum quality radiographs can be recommended where appropriate. Although designed primarily for dental X-ray units, use of the film cassette package may be extended, with suitable calibration, to general diagnostic X-ray survey measurements.

32272 (NRPB-R—165) **Quality assurance tests of the NRPB dental monitoring cassette.** Iles, W.J.; McClure, D.R.; Muirhead, C.R. (Rutherford Appleton Lab., Chilton (UK)). Jul 1984. 25p. HMSO, London, price Pound 4.00.

This report describes the tests designed to assess the performance of the NRPB dental monitoring cassette; it complements NRPB-R164. Measurements have been made for both the original and new cassettes with film manufactured by Kodak Ltd and Agfa-Gevaert Ltd. The performance parameters investigated were the ability to measure the X-ray tube potential, the filtration of the X-ray beam, the exposure given to the cassette, and the diameter of the beam. The consistency between different cassette inserts was also assessed. The values given by the processing laboratory and the values from the irradiating laboratory are presented, and the results are then analysed statistically to determine the influence of the various parameters on the assessment of individual parameters. The performance of the cassette was found to be satisfactory.

32273 (NUREG/CR—4131) **Investigation of alternative means to accomplish the goals of biennial calibration of ionization chambers.** Cameron, J.R.; DeWerd, L.A.; Goetsch, S.J.; Price, J.C. (Wisconsin Univ., Madison (USA). Dept. of Medical Physics). May 1985. 38p. NTIS, PC A03/MF A01 - GPO. File Number TI85901477.

The research described in this report was performed to investigate the feasibility of a mailed dosimetry system as an alternative method of achieving the goals of the present US Nuclear Regulatory Commission requirement that ionization chambers used for calibration of cobalt-60 teletherapy units be calibrated every two years. Both thermoluminescent dosimeters (TLD's) and diode detector units were used in this study. A total of 20 hospitals in the states of Illinois, Iowa and Wisconsin participated in a program in which this dosimetry package was sent to each institution on three separate occasions. The physicist, physician or chief technologist was asked to deliver 1.50 Gray (150 rads) to the device, assuming the device was equivalent in radiation absorption characteristics to human tissue. A treatment field size of 10cm by 10cm was chosen and the institution was requested to use their clinical source-to-surface distance. The accuracy of the beam localization as indicated by the coincidence of the light field with the radiation field was measured as well. The criterion for accuracy of dose delivery was +-5% and the criterion for light field and radiation field coincidence was +-3.0mm. Only two hospitals during the course of the study had both unacceptable diode meter and TLD readings simultaneously. Only one hospital had a disagreement of more than 3mm between the light field and the radiation field. It is recommended that such a mailed dosimetry package be considered as an alternative to the present NRC requirement for biennial calibration of ionization chambers used to calibrate cobalt-60 teletherapy sources. 5 refs., 5 tabs.

32274 (ZfI-Mitt—77, pp 78-83) **^{15}N isotopic analysis in biological materials using the ^{15}N analyzer NOI-6.** Jung, K.; Reinhardt, R.; Meier, G. (Akademie der Wissenschaften der DDR, Leipzig. Zentralinstitut fuer Isotopen- und Strahlenforschung). Sep 1983. (In German). NTIS (US Sales Only), PC A14/MF A01. File Number DE85780083. (CONF-8305218—Summ.).

From Recent results of /sup 15/N tracer technique in medicine symposium; Rostock, German D.R. (29 May 1983).

Construction and operation of the ^{15}N analyzer NOI-6 are described. In the blood of test persons and patients suffering from a liver disease the content of ammonia was determined by isotopic analysis after adding of $^{15}NH_4Cl$ to the blood.

32275 (ZfI-Mitt—77, pp 229-236) **Evaluation of the protein metabolism in patients suffering from liver cirrhosis and portal hypertension before and after shunt operations. Studies with ^{15}N-glycin.** Gehrandt, F. (Kreiskrankenhaus Pritzwalk (German Democratic Republic)); Czarnetzki, H.D. (Rostock Univ. (German Democratic Republic). Bereich Medizin); Schenker, U. (Karl-Marx-Universitaet, Leipzig (German Democratic Republic). Chirurgische Klinik); Faust, H.; Junghans, P. (Akademie der Wissenschaften der DDR, Leipzig. Zentralinstitut fuer Isotopen- und Strahlenforschung). Sep 1983. (In German). NTIS (US Sales Only), PC A14/MF A01. File Number DE85780083. (CONF-8305218—Summ.).

From Recent results of /sup 15/N tracer technique in medicine symposium; Rostock, German D.R. (29 May 1983).

The ^{15}N tracer technique is a valuable means in determining the protein metabolism of the liver in cirrhotic patients with portal hypertension. The portions of urea-N, ammonia-N, and other ^{15}N-metabolites in total urinary ^{15}N excretion were determined. Thus, the ^{15}N tracer technique is suited to help in selection and indication of surgical treatment.

32276 (ZfI-Mitt—77, pp 254-259) **Improvement of differential diagnostics in pseudohermaphroditismus masculinus by means of ^{15}N-labelled amino acids. Methodical aspects.** Willgerodt, H.; Hoepffner, W.; Keller, E. (Karl-Marx-Universitaet, Leipzig (German Democratic Republic). Bereich Medizin); Reinhardt, R.; Junghans, P. (Akademie der Wissenschaften der DDR, Leipzig. Zentralinstitut fuer Isotopen- und Strahlenforschung). Sep 1983. (In German). NTIS (US Sales Only), PC A14/MF A01. File Number DE85780083. (CONF-8305218—Summ.).

From Recent results of /sup 15/N tracer technique in medicine symposium; Rostock, German D.R. (29 May 1983).

In 7 children with male hermaphroditism the N retention test was performed using ^{15}N-glycine (13.5 mg/kg body weight). On testosterone therapy the protein synthesis rate increased significantly while there was a significant decrease in the cumulative ^{15}N excretion.

32277 (ZfI-Mitt—77, pp 274-279) **Determination of residual volume and intrapulmonal mixing ratio of gases by means of ^{15}N.** Reinhardt, R.; Faust, H. (Akademie der Wissenschaften der DDR, Leipzig. Zentralinstitut fuer Isotopen- und Strahlenforschung); Schauer, J. (Karl-Marx-Universitaet, Leipzig (German Democratic Republic). Bereich Medizin). Sep 1983. (In German). NTIS (US Sales Only), PC A14/MF A01. File Number DE85780083. (CONF-8305218—Summ.).

From Recent results of /sup 15/N tracer technique in medicine symposium; Rostock, German D.R. (29 May 1983).

In healthy controls and in patients suffering from chronic bronchitis with emphysema the residual volume of the lungs and the intrapulmonal mixing ratio of the respiratory gases were determined using ^{15}N as tracer.

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32278 **Requirements for a treatment planning system for radioimmunotherapy.** DeNardo, G.L.; Raventos, A.; Hines, H.H.; Scheibe, P.O.; Macey, D.J.; Hays, M.T.; DeNardo, S.J. (Univ. of California, Sacramento). *International Journal of Radiation Oncology, Biology and Physics;* **11**: No. 2, 335-348(Feb 1985). Contract AT03-82ER60056.

Cancer-seeking antibodies carrying radionuclides can, in theory, be very powerful agents for the radiotherapy of cancer. However, as with all radiotherapy, the undesired dose to critical normal organs is the limiting factor that determines success or failure. The distribution of radiation dose in cancer and noncancer tissue is highly dependent on choices the therapist can make: choices of the antigens to be targeted, choices of the antibodies or antibody fragments to be used, choices of radionuclides, of amounts, of timing, and other electives. New technologies, especially of monoclonal antibody production, make the options myriad. Optimization of this therapy depends on a foreknowledge of the radiation dose distributions to be expected. The necessary data can be acquired by established tracer techniques, in individual patients, for particular treatment selections. These tracer techniques can now be implemented by advanced equipment for quantitative, tomographic radionuclide imaging and strengthened by dynamic modeling of the physiological parameters which govern radionuclide distribution, and hence radiation dose distribution.

32279 **Human primary visual cortex topography imaged via positron tomography.** Schwartz, E.L. (New York University Medical Center, NY (USA). Dept. of Psychiatry); Christman, D.R.; Wolf, A.P. (Brookhaven National Lab., NY (USA). Dept. of Chemistry). *Brain Research;* **294**: No. 2, 225-230(5 Mar 1984).

The visuotopic structure of primary visual cortex was studied in a group of 7 human volunteers using positron emission transaxial tomography (PETT) and ^{18}F-labeled 2-deoxy-2-fluoro-D-glucose ([^{18}F]DG). A computer animation was constructed with a spatial structure which was matched to estimates of human cortical magnification factor and to striate cortex stimulus preferences. A lateralized cortical 'checker-board' pattern of [^{18}F]DG was stimulated in primary visual cortex by having subjects view this computer animation following i.v. injection of [^{18}F]DG. The spatial structure of the stimulus was designed to produce an easily recognizable 'signature' in a series of 9 serial PETT scans obtained from each of a group of 7 volunteers. The predicted lateralized topographic 'signature' was observed in 6 of 7 subjects. Applications of this method for further PETT studies of human visual cortex are discussed.

5507 Microbiology

32280 **(CBPF-NF—022/83) Electron microscopy and ultrastructure of a magnetotactic microorganism.** Farina, M.; Barros, H.G.deP.L. de; Esquivel, D.M.S.; Danon, J. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1983. 9p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85701468.

Transmission and scanning electron microscopy of magnetotactic microorganisms with diameter in the order of 6 μm show a complex internal structure indicating that they are a colony or aggregate of similar cells, with a large number of high density regions responsable for the observed magnetotaxis.

32281 **Competition among rhizobium species for nodulation of Leucaena leucocephala in two tropical soils.** Moawad, H.; Bohlool, B.B. (Univ. of Hawaii, Honolulu). *Applied and Environmental Microbiology;* **48**: No. 1, 5-9(Jul 1984).

The successful nodulation of legumes by a Rhizobium strain is determined by the competitve ability of that strain against the mixture of other native and inoculant rhizobia. Competition among six Leucaena rhizobial strains in single and multistrain inoculants were studied. Field inoculation trials were conducted in an oxisol and a mollisol soil, both of which contained indigenous Leucaena-nodulating rhizobia. Strain-specific fluorescent antibodies were used for the identification of the strains in Leucaena nodules. Mixtures of three recommended inoculum strains for Leucaena species (TAL82, TAL582, and TAL1145) were used in peat-based inocula either alone or with one of the three other strains isolated from the sites, B213, B214, and B215. Each of these latter three strains was also used as single-strain inocula to study their competition with the native rhizobia in the two soil systems. In the oxisol soil, strains B213 and B215, when used as single-strain inocula, outcompeted the native rhizobia and formed 92 and 62% of the nodules, respectively. Strain B214 was the least competitive in oxisol soil, where it formed 30% of the nodules, and the best in mollisol soil, where it formed 70% of the nodules. The most successful competitor for nodulation in multistrain inocula was strain TAL1145, which outcompeted native and other inoculum Leucaena rhizobia is both soils. None of the strains in single or multistrain inoculants was capable of completely overcoming the resident rhizobia, which formed 4 to 70% of the total nodules in oxisol soil and 12 to 72% in mollisol soil. No strong relationship was detected between the size of the rhizosphere population of a strain and its successful occupation of nodules. 24 references.

5509 Pathology

32282 (DOE/BP—223, pp 1-22) **Status of viral fish diseases in the Columbia River Basin.** Groberg, W.J. Jr. (Oregon State Univ., Corvallis). Apr 1983. NTIS, PC A09/MF A01. File Number DE85008089. (CONF-8210332—).

From Workshop on viral diseases of salmonid fishes in the Columbia River Basin; Portland, OR, USA (7 Oct 1982).

Recently, there have been reports of widespread viruses among salmonid fishes in the Columbia River Basin, as well as in hatcheries. A recent report indicates that mortalities to infectious hematopoietic necrosis in 1982 have average 30% in juveniles and have reached as high as 70% at certain facilities. Several hypotheses are outlined concerning the possible mechanism whereby infectious hematopoietic necrosis has suddenly assumed catastrophic proportions in salmonids of the basin.

32283 (DOE/BP—223, pp 23-50) **Methods for diagnosing IHNV infection in fish.** Leong, J.C.; Hsu, Y.L.; Engelking, H.M.; Fendrick, J.L.; Durrin, L.K.; Kurath, G. (Oregon State Univ., Corvallis). Apr 1983. NTIS, PC A09/MF A01. File Number DE85008089. (CONF-8210332—).

From Workshop on viral diseases of salmonid fishes in the Columbia River Basin; Portland, OR, USA (7 Oct 1982).

The effective management of fish health in hatcheries requires the use of rapid, accurate, and sensitive methods for diagnosing disease. Early diagnosis can result in the control of the disease with a decrease in mortality and a halt to the further spread of the infectious agent. Current methods used in viral diagnoses are reviewed. Some ways by which these methods may be used for infectious hematopoietic necrosis virus are discussed. 10 references, 11 figures, 2 tables.

32284 (DOE/BP—223, pp 51-75) **Control of mortality caused by infectious hematopoietic necrosis virus.** Mulcahy, D. (Fish and Wildlife Service, Seattle, WA). Apr 1983. NTIS, PC A09/MF A01. File Number DE85008089. (CONF-8210332—).

From Workshop on viral diseases of salmonid fishes in the Columbia River Basin; Portland, OR, USA (7 Oct 1982).

Fish mortality caused by infectious hematopoietic necrosis (IHN) virus can be prevented by following two basic principles: never use eggs taken from infected broodstock and never raise fish in a water supply contaminated with IHN virus. However, viruses remaining in the culture facility must be removed before these principles can be successfully applied. Methods of controlling these viral diseases include extermination, quarantine, and vaccines. Also, mortality can be controlled by the use of elevated water temperature and by limiting the distribution of the disease by programming stock inspections and surveillance. There is a need to avoid using IHN virus carrier female fish, as well as male fish, by broodstock culling. 5 figures, 1 table.

32285 (DOE/BP—223, pp 76-83) **Acquisition and transfer of fish health data.** Amos, K.H. (Washington Dept. of Fisheries, Olympia). Apr 1983. NTIS, PC A09/MF A01. File Number DE85008089. (CONF-8210332—).

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From Workshop on viral diseases of salmonid fishes in the Columbia River Basin; Portland, OR, USA (7 Oct 1982).

Viral diseases pose a tremendous threat to salmonid hatcheries on the Columbia River. Currently, there is a need for a program to acquisition, compile, and analyze relevant data in determining the epidemiology of these diseases. It is necessary to know the location, the virulence of the disease, the incidence, and the potential for the disease to spread. Once the viral histories of all Columbia Basin hatcheries and stocks are available, this multi-faceted tool will help to control viral diseases.

32286 (DOE/BP—223, pp 84-118) **Viral disease considerations in the commercial trout industry in Idaho.** Busch, R.A. (Clear Springs Trout Co., Buhl, ID). Apr 1983. NTIS, PC A09/MF A01. File Number DE85008089. (CONF-8210332—).

From Workshop on viral diseases of salmonid fishes in the Columbia River Basin; Portland, OR, USA (7 Oct 1982).

Fish health management of the commercial trout industry in Idaho is discussed with emphasis on virus disease control. Some important and basic differences in Idaho hatcheries are compared to hatcheries elsewhere in the Columbia River Basin. Two basic differences are a constant, year-round water temperature of 14.5°C and continuous hatchery production 12 months out of every year. These factors become critical in discussing practical and cost effective methods of viral disease control in commercial trout hatcheries. There is a great deal of movement of fish stocks, providing opportunities for the spread of the diseases. The initial appearance of infectious hematopoietic necrosis (IHN) virus began as a chronic infection of large fish in 1977 and 1978 in the Hagerman Valley. Subsequent years show infection beginning in progressively smaller fish and becoming more acute.

32287 (DOE/BP—223, pp 119-139) **Current fish disease control policies affecting the Columbia River Basin.** Rohovec, J.S. (Oregon State Univ., Corvallis). Apr 1983. NTIS, PC A09/MF A01. File Number DE85008089. (CONF-8210332—).

From Workshop on viral diseases of salmonid fishes in the Columbia River Basin; Portland, OR, USA (7 Oct 1982).

There is presently no comprehensive fish disease control policy which has been adopted and is in effect in the Columbia River Basin. However, the United States government initiated fish disease control legislation in 1958. The Title 50 law involves the entire nation but is limited in scope since it concerns regulation and control of only two specific fish pathogens. Fish disease control policies, which have been enacted by the state governments of the Colorado River drainage and the Great Lakes Fishery Commission are presented. Most individual state and federal agencies operating in the Columbia River Basin have fish disease control guidelines which they follow. The policies of Washington, Oregon, Canada and the US Fish and Wildlife Service are discussed. 4 references, 1 table.

32288 (DOE/BP—223, pp 140-150) **Proposed viral disease control policies for the Columbia River Basin.** Wold, E. (National Marine Fisheries Service, Portland, OR). Apr 1983. NTIS, PC A09/MF A01. File Number DE85008089. (CONF-8210332—).

From Workshop on viral diseases of salmonid fishes in the Columbia River Basin; Portland, OR, USA (7 Oct 1982).

Recommendations are presented for the control of virus diseases in anadromous fish for long term comprehensive plans and short term crisis control. These plans include identifying infected stocks, eliminating infected individuals from stocks, preventing the artificial movement of infected stocks, controlling water supplies and hatchery management practices to reduce horizontal modes of infection and establishing a network of information exchange.

32289 (DOE/BP—223, pp 151-158) **Fish disease research: BPA funding guidelines.** Barila, T.Y. (Bonneville Power Administration, Portland, OR). Apr 1983. NTIS, PC A09/MF A01. File Number DE85008089. (CONF-8210332—).

From Workshop on viral diseases of salmonid fishes in the Columbia River Basin; Portland, OR, USA (7 Oct 1982).

In 1980 Congress passed the Pacific Northwest Electric Power Planning and Conservation Act (Regional Act). This Act gave authority to Bonneville Power Administration of Portland, Oregon, to protect, mitigate, and enhance fish and wildlife resources affected by the development and operation of hydroelectric projects on the Columbia River and its tributaries. Under the mandate of Section 4(h) of the Regional Act, the Northwest Power Planning Council (Council) was to develop a Fish and Wildlife Program. Bonneville Power Administration's role is to be used to implement measures that are consistent with the Council's Fish and Wildlife Program. One major objective, which is presented in detail, concerns improving artificial production technology because hatcheries are a crucial link in the restoration of the Columbia River fishery. The evaluation criteria which Bonneville Power Administration has developed to assist in the selection of proposals for funding support are discussed.

32290 (DOE/BP—223, pp 159-173) **Priority research needs concerning fish viruses prevalent among Columbia River basin salmonids.** Groberg, W.J. Jr. (Oregon State Univ., Corvallis). Apr 1983. NTIS, PC A09/MF A01. File Number DE85008089. (CONF-8210332—).

From Workshop on viral diseases of salmonid fishes in the Columbia River Basin; Portland, OR, USA (7 Oct 1982).

The research needs concerning the viruses of fish in the Columbia River Basin are outlined and the rationale behind this outline is described. These needs include: epidemiology of infectious hematopoietic necrosis virus and infectious pancreatic necrosis virus; pathogenesis of infectious menatopoietic necrosis; methods for control of infectious hematopoietic necrosis; and develop a rapid diagnostic method for detection of infectious pancreatic necrosis virus in asymptomatic fish. The research, tests and investigations outlined represented those immediate needs for the Columbia River Basin agreed upon by a consensus of fish pathologists from every governmental agency responsible for fish propagation in Idaho, Washington and Oregon.

5510 Physiological Systems

REFER ALSO TO CITATION(S) 31696

32291 (ZfI-Mitt—77, pp 155-166) **Determination of endogenous nitrogen in the chyme using ^{15}N tracers.** Gebhardt, G.; Souffrant, W.B.; Koehler, R. (Karl-Marx-Universitaet, Leipzig (German Democratic Republic). Sektion Tierproduktion und Veterinaermedizin). Sep 1983. (In German). NTIS (US Sales Only), PC A14/MF A01. File Number DE85780083. (CONF-8305218—Summ.).

From Recent results of /sup 15/N tracer technique in medicine symposium; Rostock, German D.R. (29 May 1983).

The endogenous N content of small intestine chyme, feces, urine and blood as well as its portion in total N were determined in swine by means of ^{15}N-labelled glycine and leucine, resp.

32292 (ZfI-Mitt—77, pp 219-228) **Characterization of the detoxifying function of the liver as evidenced by [^{13}C, ^{15}N]methacetin.** Krumbiegel, P.; Hirschberg, K. (Akademie der Wissenschaften der DDR, Leipzig. Zentralinstitut fuer Isotopen- und Strahlenforschung); Guenther, K. (Karl-Marx-Universitaet, Leipzig (German Democratic Republic). Radiologische Klinik). Sep 1983. (In German). NTIS (US Sales Only), PC A14/MF A01. File Number DE85780083. (CONF-8305218—Summ.).

From Recent results of /sup 15/N tracer technique in medicine symposium; Rostock, German D.R. (29 May 1983).

In test persons and patients suffering from liver cirrhosis the detoxification of the xenobiotic methacetin in the liver was studied by breath test and chromatographic determination of metabolites in urine and serum using ^{14}C, ^{13}C and ^{15}N as tracers.

5530 Agriculture And Food Technology

REFER ALSO TO CITATION(S) 31349, 31701, 32281

32293 (PNL-SA—9230-Rev.) Burning and clipping effects on bluebunch wheatgrass productivity. Revision. McShane, M.C.; Sauer, R.H. (Pacific Northwest Labs., Richland, WA (USA)). Feb 1983. Contract AC06-76RL01830. 16p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85012982.

This study compared the response of bluebunch wheatgrass (Agropyron spicatum (Pursh) Scribner and Smith) to the removal of standing dead grass by burning and by clipping. Dormant plants were either clipped or burned in September, individually, or as part of a 3.14 m^2 area centered on the study plant. This treatment design allowed determination of the effect of competition on productivity. Clipping and burning of dormant bluebunch wheatgrass clumps significantly shortened leaf length. Biomass and the formation of seedheads were significantly reduced by clipping but not by burning. The lack of measurable effects between plants treated alone and as part of a surrounding treated area suggests that competition from nearby individuals had an insignificant role in regulating bluebunch wheatgrass productivity in the first season after treatment. 13 refs., 1 fig., 1 tab.

56 BIOMEDICAL SCIENCES, APPLIED STUDIES

5601 Radiation Effects

REFER ALSO TO CITATION(S) 32010, 32011, 32012, 32817

32294 (AECL—8061) Effects of ionizing radiation and review of the Young-Woollard document. Marko, A.M.; Myers, D.K. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Apr 1983. 16p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85701469.

A review of a document entitled 'The Health Dangers of Uranium Mining and Jurisdictional Questions' has been prepared. E.R. Young and R.F. Woollard submitted, in 1980, this document to the British Columbia Royal Commission of Inquiry, Health and Environmental Protection - Uranium Mining (INIS-mf--7757). When we reviewed the document it became clear that the views concerning effects of low-level radiation including alpha irradiation do not have scientific consensus. For this reason we have included a brief summary of conclusions produced by various international and national bodies on the effects of radiation on humans.

32295 (AECL—8183) Updated follow-up of long-term Chalk River employees. Werner, M.M.; Myers, D.K.; Morrison, D.P. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Aug 1983. 23p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85701475.

Data on the follow-up of CRNL employees who died during employment or after retirement have been updated to 1982 December 31. Updated tables on mortality for AECL participants in the 1953 NRX clean-up and in the 1958 NRU decontamination are also included in this report. Preliminary mortality data on two other groups are presented here for (a) female employees of CRNL, 1966-1982 and (b) male employees of CRNL who have accumulated lifetime occupational doses of 0.2 Sv (20 rem) or more. Data on types of fatal cancer recorded for long-term male CRNL employees over the period 1966-1982 are also given. No statistically significant increases in cancer deaths were found in any of the groups analyzed.

32296 (DOE/ER/60169—T2) Delayed immunologic effects of low dose radiation in Japanese A-bomb survivors. Technical progress report. Makinodan, Takashi. (California Univ., Los Angeles (USA)). 1985. Contract AT03-83ER60169. 6p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85011703.

Samples collected from 832 A-bomb survivors were analyzed for natural killer activity, interleukin production, interferon production, serum interferon levels, and circulating immune complex levels. The most striking finding was a significant radiation-sex interaction for NK activity. The NK of females exposed to 100+ rads was decreased compared to those exposed to 0 to 99 rads. A significant increase in NK activity with age ATB was observed, as well as an increase with age in circulating immune complex. (ACR)

32297 (DOE/PE—0072) Radiation exposures for DOE and DOE contractor employees - 1983. Sixteenth annual report. (Pacific Northwest Labs., Richland, WA (USA)). Oct 1984. Contract AC06-76RL01830. 61p. NTIS, PC A04/MF A01; GPO Dep. File Number DE85013023.

A total of 88,283 DOE and DOE contractor employees were monitored for whole-body ionizing radiation exposures in 1983. This represents 56.6% of all DOE and DOE contractor employees and is an increase from the number of individuals monitored in 1982. In addition to the employees, 84,851 visitors were monitored. Of all employees monitored, 56.5% received a dose equivalent that was less than measurable, 41.6% a measurable exposure less than 1 rem, and 1.9% an exposure greater than 1 rem. The exposure received by 94.6% of the visitors to DOE facilities was less than measurable. Only 5.4% of the visitors received a measurable exposure less than 1 rem, and <0.01% of the visitors received an exposure greater than 1 rem. No employees or visitors received a dose equivalent greater than 5 rem. The collective dose equivalent for DOE and DOE contractor employees was 7858 person-rem. The collective dose equivalent for visitors was 300 person-rem. The average dose equivalent for all individuals monitored was 47 mrem and the average dose equivalent for all individuals who received a measurable exposure was 190 mrem. The highest average dose equivalent for all monitored employees was observed at fuel fabrication facilities (235 mrem) and the lowest among visitors (4 mrem) to DOE facilities. These averages are significantly less than the DOE 5-rem/y radiation protection standard for whole-body exposures. Five cases of internal depositions were reported in 1983. In all cases, the depositions were less than the annual dose-equivalent standard. Internal depositions were the result of accidental, not planned, exposures. A total of 7449 monitored employees terminated their employment in 1983. The average cumulative dose equivalent for terminated employees who worked one to two years was 0.33 rem; two to four years, 0.30 rem; four to six years, 0.41 rem; and longer than six years, 3.70 rem. 5 figs., 10 tabs.

32298 (GSF-S—1063) 1983 statistical results of the Official Personal Dosimetry Service. Drexler, G.; Eckerl, H.; Haid, G.; Scheibe, D. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Auswertungsstelle fuer Strahlendosimeter). Jul 1984. 41p. (In German). NTIS (US Sales Only), PC A03/MF A01. File Number DE85751648.

The report consists of a summary of relevant statistical data from the official personal dosimetry in 1983. Under survey were occupationally exposed persons in the states of Bavaria, Hessen and Schleswig-Holstein. The data are based on the survey of nearly 6,400 institutions with nearly 70,000 persons and are derived from approx. 840,000 single measurements. The report covers informations on the institutions, on the persons as well as dosimetric values. The measuring method is described briefly with respect to dosimeters used, their range and the interpretation of values. Information on notional doses and the interpolation of values nearby the detection limits are given.

32299 (IA—1404, pp 184-185) Mechanism of action of radioprotectors Part I. Effect of WR-2721 and cysteamine on DNA strand breaks. Prager, A.; Green, M.; Riklis, E. Jul 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85780940.

Published in summary form only.

In Research laboratories annual report 1983.

32300 (IA—1404, pp 185-186) **Increased survival of irradiated mammalian cells afforded by WR-2721 and activated microsomal preparation.** Green, M.; Prager, A.; Riklis, E. Jul 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85780940.

Published in summary form only.
In Research laboratories annual report 1983.

32301 (IA—1404, pp 187-188) **Cellular levels of NAD as a limiting factor in ability to repair DNA radiation damage.** Riklis, E.; Kol, R.; Marko, R. Jul 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85780940.

Published in summary form only.
In Research laboratories annual report 1983.

32302 (IA—1404, pp 189-190) **Poly(ADP-ribose) plays a role in the repair of 5-bromodeoxyuridine photolysis damage in DNA of Chinese hamster cells.** Ben-Hur, E. (Israel Atomic Energy Commission, Tel Aviv); Lindquist, K.; Elkind, M.M. (Colorado State Univ., Fort Collins (USA)). Jul 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85780940.

Published in summary form only.
In Research laboratories annual report 1983.

32303 (IA—1404, pp 190) **Role of poly(ADP-ribose) in repair of alkylation damage in DNA. Studies with alkylation sensitive mutant of Chinese hamster cells.** Ben-Hur, E. Jul 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85780940.

Published in summary form only.
In Research laboratories annual report 1983.

32304 (IA—1404, pp 193-194) **Neonatal low dose γ-irradiation induced fertility disorders in mature female rats.** Freud, A. (Israel Atomic Energy Commission, Tel Aviv); Bedrak, E. (Ben-Gurion Univ. of the Negev, Beersheba (Israel)). Jul 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85780940.

Published in summary form only.
In Research laboratories annual report 1983.

32305 (IA—1404, pp 203) **Radiological risks to the population of Israel following penetration of radioactive fallout into food chains.** Koch, J.; Tadmor, J. Jul 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85780940.

Published in summary form only.
In Research laboratories annual report 1983.

32306 (IA—1404, pp 194-195) **Low-dose irradiation of fresh non-frozen chicken to extend shelf-life and eliminate pathogenic bacteria.** Eisenberg, E.; Lapidot, M. (Israel Atomic Energy Commission, Tel Aviv); Klinger, I. (Veterinary Inst., Bet Dagan (Israel)); Baskar, D. (Ministry of Agriculture, Bet Dagan (Israel). Agricultural Research Organization). Jul 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85780940.

Published in summary form only.
In Research laboratories annual report 1983.

32307 (IA—1404, pp 209-211) **External measurement of ^{239}Pu in human lung with a NaI-CsI Phoswich detector.** Laichter, Y.; German, U.; Rom, E.; Weiser, G. Jul 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85780940.

Published in summary form only.
In Research laboratories annual report 1983.

32308 (IAEA-TECDOC—323, pp 83-105) **Preservation and preparation of biological materials for trace element analysis: quality assurance considerations.** Iyengar, G.V. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Medizin). Nov 1984. NTIS (US Sales Only), PC A10/MF A01. File Number DE85780941. (CONF-8209272—Summ.).

From Advisory group meeting on quality assurance in biomedical neutron activation analysis; Vienna, Austria (13 Sep 1982).

Trace element research at lower concentration levels imposes strict requirements on its practitioners. The analyses must be carried out under rigorously controlled conditions to protect the sample from artefacts due to the containers, the reagents and the ambient air. Essential guidelines covering general aspects of solid and liquid biomedical samples, specimen preservation and storage, sample handling tools, cleaning procedures for laboratory wares and practical steps in sample treatment such as washing procedures, drying, ashing, homogenization and some aspects of the analytical aliquot, are presented. It is stressed that no programme of low-level trace element analyses work should be started before adequate procedures for control of contamination have been developed. The implications of many intriguing factors and the steps necessary for their control involve the competence of several disciplines, thus making team work an essential component of biomedical trace element research.

32309 (INFO—0081) **Risk estimates for the health effects of alpha radiation.** Thomas, D.C.; McNeill, K.G. (Atomic Energy Control Board, Ottawa, Ontario (Canada)). Sep 1981. 335p. NTIS (US Sales Only), PC A15/MF A01. File Number DE85701050.

This report provides risk estimates for various health effects of alpha radiation. Human and animal data have been used to characterize the shapes of dose-response relations and the effects of various modifying factors, but quantitative risk estimates are based solely on human data: for lung cancer, on miners in the Colorado plateau, Czechoslovakia, Sweden, Ontario and Newfoundland; for bone and head cancers, on radium dial painters and radium-injected patients. Slopes of dose-response relations for lung cancer show a tendency to decrease with increasing dose. Linear extrapolation is unlikely to underestimate the excess risk at low doses by more than a factor of 1.5.

32310 (INFO—0093) **Field measurements of mixed exposure of operators to radioactive aerosol, gas and quartz in confinement of mining equipment cabs during open-pit mining of high-grade uranium ores.** Yoshida, K.; Atiemo, M.A.; Markham, J.W. (Atomic Energy Control Board, Ottawa, Ontario (Canada)). Jul 1982. 64p. NTIS (US Sales Only), PC A04/MF A01. File Number DE85701236.

Prepared for the Atomic Energy Control Board.

A series of field measurements of miners mixed exposure to radon and daughters, uranium ore dust and respirable quartz, was conducted in an open-pit mine in Northern Saskatchewan during 1980-81. Control of radon gas levels in the mining equipment cabs is required. Dust may be reduced by minimizing the resuspension of dust from contaminated surfaces within the cabs.

32311 (INS-R—315) **Stable Isotope Group 1982 progress report.** Stewart, M.K. (ed.). (Department of Scientific and Industrial Research, Lower Hutt (New Zealand). Inst. of Nuclear Sciences). Jun 1983. 34p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85701535.

The work of the Stable Isotope Group of the Institute of Nuclear Sciences during 1982, in the fields of isotope geology, isotope hydrology, geochronology, isotope biology and mass spectrometer instrumentation, is described.

32312 (JAERI-M—83-161) **Irradiation effect on animal feeds and feedstuffs.** Kume, Tamikazu. (Japan Atomic Energy Research Inst., Tokyo). Oct 1983. 103p. (In Japanese). NTIS (US Sales Only), PC A06/MF A01. File Number DE85701051.

Aiming to secure the safety of animal feeds and develop the new resources, the effect of γ-irradiation on disinfection and the changes in components were investigated. Salmonellae and coliforms contaminating animal feeds and feedstuffs were eliminated by 0.5 – 0.6 Mrad and 0.5 – 0.8 Mrad, and osmophilic moulds were sterilized by 0.7 – 0.75 Mrad. From these results, it is concluded that the dose for disinfection of animal feeds is 0.8 Mrad. The main components were hardly changed by irradiation up to 5 Mrad, and the component changes in irradiated samples could be suppressed during storage while the components in unirradiated samples were markedly changed with the growth of osmophilic moulds. Histamine and lysinoalanine, which may cause the feed poisoning, were never accumulated in feedstuffs by irradiation. The nutritional value of chick feeds was not changed by 1.0 Mrad irradiation. From these results, it is considered that no problem for wholesomeness of animal feeds occurs by irradiation. Therefore, the irradiation is effective for disinfection and keeping the nutritional value of animal feeds during storage. Irradiation promotes the recovery of proteins in the wastewater by coagulation of proteins and improves the property of coagulants due to the degradation of polysaccharides. These results indicate that irradiation is effective to develop the new resources for animal feeds.

32313 (JINR—19-83-884) **Role of DNA repair in the realization of oxygen effect in bacteria Escherichia coli irradiated with various types of radiation. The balance of repair systems and the sensitivity to radiation.** Kozubek, S.; Krasavin, E.A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1983. 12p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85701049.

The role of the balance of E. coli repair systems in the sensitivity to ionizing radiation of different LETs is considered. The influence of modifying factors on the balance between fast (2) and slow (3) repair systems is analysed. It is shown that in the case of γg-irradiation of aerobic cells the decreased power of repair 3 in some limits can be compensated by increased power of repair 2 so that the sensitivity remains constant. In anaerobic conditions decreasing power of repair 3 leads inevitably to markedly increased sensitivity. Different mechanisms of the action of radioprotectors on the repair balance in aerobic or anaerobic state are discussed. The role of repair balance in the radiosensitivity of irradiated wild type cells is shown to become unimportant for high LET radiation owing to the presence of markedly increased ratio of direct double-strand breaks.

32314 (KFK—3782) **Triennial report 1981-83 of the Institute for Genetics and for Toxicology.** Hotz, G. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Genetik und Toxikologie von Spaltstoffen). Jul 1984. 180p. NTIS (US Sales Only), PC A09/MF A01. File Number DE85780948.

The scientific activity of the Divisions of Genetics and of Toxicology of the Institute for Genetics and for Toxicology during the period January 1981 to December 1983 is described. In addition to reports on the various research topics this second 'Report' also gives an overview of the external scientific and teaching activities of the staff members during the period. In the field of radiation genetics most of the interest has been focussed on the mechanisms of gene repair, gene regulation and the molecular biology of tumor viruses in human and other mammalian cells. The main emphasis of the long term toxicology program has been on studies of radiotoxicology of the actinides and other heavy metals, especially in relation to chelation therapy and to the development of biochemical and physical methods for investigation of their metabolic behaviour.

32315 (LBL—19500) **Role of protein synthesis in the repair of sublethal x-ray damage in a mutant Chinese hamster ovary cell line.** Yezzi, M.J. (Lawrence Berkeley Lab., CA (USA)). Apr 1985. Contract AC03-76SF00098. 158p. NTIS, PC A08/MF A01; GPO Dep. File Number DE85011990.

Thesis.

A temperature-sensitive mutant for protein synthesis, CHO-TSH1, has been compared to the wild-type cell, CHO-sC1, in single- and split-radiation-dose schemes. When the exponentially growing TS mutant and the wild-type cells were treated at 40$_{o}$C for up to 2 hrs prior to graded doses of x rays, the survival curves were identical and were the same as those obtained without heat treatment. If the cultures were incubated at 40°C for 2 hrs before a first dose and maintained at 40°C during a 2 hr dose fractionation interval, repair of radiation damage was reduced in the mutant compared to the wild type. These observations implied that a pool of proteins was involved in the repair of sublethal x-ray damage. However, if repair was measured by the alkaline-unwinding technique under the same time and temperature schemes, no difference in the kientics of DNA strand rejoining was observed. Misrepair processes may permit restoration of DNA strand integrity but not allow functional repair. The effect of diminished repair under conditions of inhibition of protein synthesis was found to be cell-cycle dependent in survival studies with synchronized mutant cell populations. Repair was found to be almost completely eliminated if the temperature sequence described above was applied in the middle of the DNA synthetic phase. Treatment of cell populations in the middle of G_1-phase yielded repair inhibition comparable to that observed with the asynchronous cells. Splitdose experiments were done using pre-incubation with cycloheximide to chemically inhibit protein synthesis. WT cells and TS cells were treated with cycloheximide at 35°C for 2 hrs before a first dose and during a 2 hr dose fractionation interval. 23 figs., 7 tabs.

32316 (N—85-17550) **Computer subroutines for estimation of human exposure to radiation in low Earth orbit.** Cucinotta, F.A.; Wilson, J.W. (National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center). Feb 1985. 26p. (NASA-TM—86324; L—15865). NTIS, PC A03/MF A01.

Computer subroutines to calculate human exposure to trapped radiations in low Earth orbit (LEO) on the basis of a simple approximation of the human geometry by spherical shell shields of varying thickness are presented and detailed. The subroutines calculate the dose to critical body organs and the fraction of exposure limit reached as a function of altitude of orbit, degree of inclination, shield thickness, and days in mission. Exposure rates are compared with current exposure limits.

32317 (NAC-AR—84-01, pp 233-234) **Report of the Van de Graaff Group: radiobiology. Radiation-induced damage and carcinogenesis in cultured human cells.** Renan, M.J.; Van der Riet, F. (Cape Town Univ. (South Africa). Dept. of Medical Microbiology); Parker, I. (Cape Town Univ. (South Africa). Dept. of Medical Biochemistry). 1984. NTIS (US Sales Only), PC A14/MF A01. File Number DE85780939.

In Annual report June 1984. [Council for Scientific and Industrial Research, Faure (South Africa). National Accelerator Center].

There exists a need for relevant information on the molecular and cellular processes induced by radiation. In this project several aspects of the problem of developing a human tumor model and growing human cells in culture, have been investigated. Human embryo fibroblasts were grown in 1000 mm plastic Petri dishes in a suitable nutrient medium, supplemented with 10% fetal calf serum and antibiotics. The following series of mutagens were utilized: ultra-violet radiation, chemical carcinogens and nucleosite analogues, such as 5-azacytidine (aza C). Some of the treated human fibroblasts were also examined by electron microscopy and the reverse transcriptase assay.

32318 (NAC-AR—84-01, pp 238) **Report of the Van de Graaff Group: NUCOR Isotope Unit. Tritium levels and body burdens near the accelerators.** Bain, C.A.R.; Hanekom, J. 1984. NTIS (US Sales Only), PC A14/MF A01. File Number DE85780939.

Short note.

In Annual report June 1984. [Council for Scientific and Industrial Research, Faure (South Africa). National Accelerator Center].

32319 (NIRS-M—41, pp 35-45) **Mutation in cultured mammalian cells. Dose and dose-rate effects.** Nakamura, N.; Okada, S. (Tokyo Univ. (Japan). Faculty of Medicine). Mar 1982. NTIS (US Sales Only), PC A15/MF A01. File Number DE85781032. (CONF-811082—).

From Workshop on tritium radiobiology and health physics; Chiba, Japan (1 Oct 1981).

Mammalian cell cultures were exposed to gamma-rays at various dose rates. Dose-rate effects were observed in cultured somatic cells of the mouse for cell killing and mutations resistant to 6-thioguanine (TGsup(r)) and to methotrexate (MTXsup(r)). Linear quadratic model may be applied to cell killing and TGsup(r) mutations in some cases but can not explain the whole data. Results at low doses with far low dose-rate were not predictable from data at high doses with acute or chronic irradiation. Radioprotective effects of dimethyl sulfoxide were seen only after acute exposure but not after chronic one, suggesting that damages by indirect action of radiations may be potentially reparable by cells. TGsup(r) mutations seem to contain gross structural changes whereas MTXsup(r) ones may have smaller alterations.

32320 (NIRS-M—41, pp 46-59) **Transformation and mutation of golden hamster embryo cells induced by low doses of x-rays.** Watanabe, M.; Suzuki, N.; Nikaido, O. (Kanazawa Univ. (Japan). Faculty of Pharmaceutical Sciences). Mar 1982. NTIS (US Sales Only), PC A15/MF A01. File Number DE85781032. (CONF-811082—).

From Workshop on tritium radiobiology and health physics; Chiba, Japan (1 Oct 1981).

A new cell system which makes quantitative analysis possible in both mutation and transformation induced by low doses of X-rays was described and the frequencies of both mutation and transformation were compared in relation to DNA repair which takes place in X-irradiated cells. Golden hamster embryo (GHE) cells were employed to show the availability of the system for the efficient detection of both mutants and transformants concomitantly. The mutation frequency of the cell population irradiated with various doses of X-rays was expressed as the ratio of the number of 8-azaguanine resistant colonies to the 10^5 colonies formed in normal medium. A linear increase in mutation frequency with increasing dose was observed at doses ranging from 100 to 600 rad. There was no significant increase in mutation frequency with doses below 100 rad. On the other hand, the transformation frequency of the cells was expressed as the ratio of the number of the transformed colonies to the total number of colonies counted. A drastic increase in the transformation frequency was observed when cells were irradiated with less than 100 rad of X-rays. DNA repair might be involved in modifying transformation frequency and survivals of GHE cells, and DNA synthesis might be involved in inducing transformation in GHE cells. It seems that the repair of potentially lethal damage taking place in density-inhibited GHE cells within 24 hours after X-irradiation decreases the frequencies of both transformation and mutation. Furthermore, it is evident that the system using GHE cells is sensitive enough to assess the transformational effect of low doses of X-rays.

32321 (NIRS-M—41, pp 60-67) **Radiation effects on cultured mouse embryos in relation to cell division cycle.** Domon, M. (Tokyo Medical and Dental Univ. (Japan). School of Dentistry). Mar 1982. NTIS (US Sales Only), PC A15/MF A01. File Number DE85781031. (CONF-811082—).

From Workshop on tritium radiobiology and health physics; Chiba, Japan (1 Oct 1981).

The authors have worked with mouse embryos in vitro asking first, what are the suitable parameters to define the radiation sensitivity of embryos, and second what is a major factor determining it. The LD_{50} was adopted as a parameter of the radiation sensitivity of a population in a mouse embryo system in culture. The fertilized ova were collected into Whitten's medium at various times during the pronuclear and 2-cell stages of development. They were irradiated in chambers with X-rays at doses of 0 to 800 rads. After the embryos were cultured, a set of the lethal fractions for various X-ray doses were obtained. Regarding the radiation sensitivity variation of the embryos, the LD_{50} varied from 100 to 200 rads during the pronuclear stage and from 100 to 600 rads during the 2-cell stage. The embryos during the pronuclear stage were most radioresistant at early G_2 phase, followed by an increase in the sensitivity. The embryos during the 2-cell stage were also most radioresistant at early G_2 phase and were more sensitive when they got close to either the first or the second cleavage division. Furthermore, it seems that the factor 6 of the large variation was due to the extremely long G_2 period, 14 hrs for the 2-cell embryos. That is, the pooled 2-cell embryos were in a relative sense well synchronized with G_2 phase. In contrast, the synchrony was poor during the pronuclear stage, which led to less variation of the LD_{50} for the pronuclear embryos. It is concluded that during the early cleavage stages of mice, radiosensitivity is mainly governed by the content of cells of various cell cycle ages in the embryo.

32322 (NIRS-M—41, pp 101-119) **Genetic and somatic effects in animals maintained on tritiated water. Special consideration of tritium distribution, turnover and microdosimetry.** Carsten, A.L.; Commerford, S.L.; Cronkite, E.P. (Brookhaven National Lab., Upton, NY (USA)); Brooks, A. Mar 1982. NTIS (US Sales Only), PC A15/MF A01. File Number DE85781031. (CONF-811082—).

From Workshop on tritium radiobiology and health physics; Chiba, Japan (1 Oct 1981).

Somatic and genetic effects of the continuous ingestion of tritiated water (HTO) at concentrations of 0.3, 1.0 and 3.0 μCi/ml were investigated in mice of the Hale-Stoner-Brookhaven strain. At these levels, there was no measurable somatic effect. Although genetic effects as measured by dominant lethal mutation (DLM) assay indicated a significant effect ($P>0.01$) on the number of viable embryos and early deaths in the 3.0 μCi/ml HTO group and on the number of viable embryos in the 1.0 μCi/ml HTO group, no genetic effects were significantly noted in the 0.3 μCi/ml HTO group. Liver cytogenetic studies showed a significant increase in the number of abnormal cells in the 3.0 μCi/ml HTO group. A reduction in bone marrow stem cells, without an attendant reduction in total marrow cellularity, was noted in the 3.0 and 1.0 μCi/ml HTO groups. There was no significant difference in any of the DLM parameters between animals maintained on 3.0 μCi/ml of HTO and animals exposed to the equivalent ^{137}Cs gamma dose (22 hours/day exposure). Consideration of the relative amounts and biological half lives of tritium present in the nucleus as water, DNA and histone suggests that after transient exposure to tritiated water, nearly all significant radiation damage can be attributed to tritium present in the nucleus as water. These data suggest that hazards from tritium attendant with normal reactor operation should not at this time be considered as a deterrent to the further development of fission and/or fusion reactor technology.

32323 (NIRS-M—41, pp 120-134) **Low-exposure tritium radiotoxicity in mammals.** Dobson, R.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Mar 1982. NTIS (US Sales Only), PC A15/MF A01. File Number DE85781031. (CONF-811082—).

From Workshop on tritium radiobiology and health physics; Chiba, Japan (1 Oct 1981).

A special feature of tritium radiation is the very low energy of the beta particles (5.7 keV average, 18 keV maximum). This low energy results in very short particle ranges in tissue, ranges that are less than cell dimensions. Another result of the low energy is that the ionization density along beta-ray tracks (even though the tracks are short) is significantly greater than that associated with secondary electrons from gamma rays. The studies of tritium radiotoxicity reviewed, involving chronic ^{3}HOH exposures in mammals, demonstrate in both mice and monkeys that biological effects can be measured following remarkably low levels of exposure — levels in the range of serious practical interest to radiation protection.

32324 (NIRS-M—41, pp 219-227) **Metabolism of tritiated water in foetuses and newborn mice.** Ujeno, Y.; Takimoto, K. (Kyoto Univ. (Japan). Faculty of Medicine). Mar 1982. NTIS (US Sales Only), PC A15/MF A01. File Number DE85781031. (CONF-811082—).

From Workshop on tritium radiobiology and health physics; Chiba, Japan (1 Oct 1981).

The compartment models of transplacental transfer of tritiated water injected into pregnant females, to foetuses and of lacteal transfer of tritiated water injected into nursing females, to suckling newborn mice were presented, respectively. There are many assumptions in the models and they do not fit the experimental data well. However, some of the differences between the models and experimental data can be qualitatively explained by physiological reasoning. The changes in the kidney functions of pregnant women are also the important factors which have to be considered to analyze the dynamics. The present dynamics analyses with mice can contribute to the understanding of the dynamics of tritiated water in humans.

32325 (NUREG—1134) **Radiation protection training for personnel employed in medical facilities.** McElroy, N.L.; Brodsky, A. (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research). May 1985. 59p. NTIS, PC A04/MF A01 - GPO. File Number TI85901511.

This report provides information useful for planning and conducting radiation safety training in medical facilities to keep exposures as low as reasonably achievable, and to meet other regulatory, safety and loss prevention requirements in today's hospitals. A brief discussion of the elements and basic considerations of radiation safety training programs is followed by a short bibliography of selected references and sample lecture (or session) outlines for various job categories. This information is intended for use by a professional who is thoroughly acquainted with the science and practice of radiation protection as well as the specific procedures and circumstances of the particular hospital's operations. Topics can be added or substracted, amplified or condensed as appropriate. 8 refs.

32326 (OEFZS—4307) **DNA metabolism and poly(ADP-ribose)-synthesis in lymphocytes of persons exposed to low doses of ionizing radiation.** Klein, W.; Kocsis, F.; Topaloglou, A. (Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H.). Jan 1985. 15p. (In German). (BL—496/85). NTIS (US Sales Only), PC A02/MF A01. File Number DE85701470.

Genetic parameters, like semiconservative DNA synthesis, UDS after UVC in vitro, sedimentation of nucleoids and PAR synthesis, are influenced in lymphocytes of persons exposed to low doses of ionizing radiation. These effects are dependent on the topicality of the charge.

32327 (ORNL—6164) **1983 international intercomparison of nuclear accident dosimetry systems at Oak Ridge National Laboratory.** Swaja, R.E.; Greene, R.T.; Sims, C.S. (Oak Ridge National Lab., TN (USA)). Apr 1985. Contract AC05-84OR21400. 42p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85011303.

An international intercomparison of nuclear accident dosimetry systems was conducted during September 12-16, 1983, at Oak Ridge National Laboratory (ORNL) using the Health Physics Research Reactor operated in the pulse mode to simulate criticality accidents. This study marked the twentieth in a series of annual accident dosimetry intercomparisons conducted at ORNL. Participants from ten organizations attended this intercomparison and measured neutron and gamma doses at area monitoring stations and on phantoms for three different shield conditions. Results of this study indicate that foil activation techniques are the most popular and accurate method of determining accident-level neutron doses at area monitoring stations. For personnel monitoring, foil activation, blood sodium activation, and thermoluminescent (TL) methods are all capable of providing accurate dose estimates in a variety of radiation fields. All participants in this study used TLD's to determine gamma doses with very good results on the average. Chemical dosemeters were also shown to be capable of yielding accurate estimates of total neutron plus gamma doses in a variety of radiation fields. While 83% of all neutron measurements satisfied regulatory standards relative to reference values, only 39% of all gamma results satisfied corresponding guidelines for gamma measurements. These results indicate that continued improvement in accident dosimetry evaluation and measurement techniques is needed.

32328 (PNL—5500-Pt.1, pp 39-41) **Inhalation hazards to uranium miners.** Cross, F.T. Feb 1985. NTIS, PC A07/MF A01. File Number DE85009365.

In Pacific Northwest Laboratory annual report for 1984 to the DOE Office of Energy Research. Part 1. Biomedical sciences.

This project is investigating levels of uranium mine air contaminants, using both large and small experimental animals to model human respiratory system disease. Lung cancer and deaths by degenerative lung disease have reached epidemic proportions among uranium miners, but the cause-effect relationships for these diseases are based on inadequate epidemiological data. This project identifies agents or combinations of agents (both chemical and radiological), and their exposure levels, that produce respiratory tract lesions, including respiratory epithelial carcinoma, pneumoconiosis, and emphysema. Histopathologic data from rats are shown for approximately 300- to 10,000-working-level-month (WLM) radon-daughter exposures. Exposure of male rats to radon daughters and uranium ore dust continues, along with exposure of male and female beagle dogs to uranium ore dust alone. 4 tables.

32329 (PNL—5500-Pt.1, pp 13-22) **Inhaled plutonium oxide in dogs.** Park, J.F. Feb 1985. NTIS, PC A07/MF A01. File Number DE85009365.

In Pacific Northwest Laboratory annual report for 1984 to the DOE Office of Energy Research. Part 1. Biomedical sciences.

This project is concerned with long-term experiments to determine the lifespan dose-effect relationships of inhaled $^{239}PuO_2$ and $^{238}PuO_2$ in beagles. The data will be used to estimate the health effects of inhaled transuranics. Beagle dogs given a single exposure to $^{239}PuO_2$ or $^{238}PuO_2$ aerosols to obtain graded levels of initial lung burdens are being observed for lifespan dose-effect relationships. Mortality due to radiation pneumonitis and lung tumor increased in the four highest dose-level groups exposed to $^{239}PuO_2$, during the 13-yr postexposure period. During the 10 1/2 years after exposure to $^{238}PuO_2$, mortality due to lung and/or bone tumors increased in the three highest dose-level groups. Chronic lymphopenia, occurring 0.5 to 2 year after exposure, was the earliest observed effect after inhalation of either $^{239}PuO_2$ or $^{238}PuO_2$ in the four highest dose-level groups that had initial lung burdens $\geqq$ 80 nCi. 3 figures, 6 tables.

32330 (PNL—5500-Pt.1, pp 28-30) **Low-level $^{239}PuO_2$ lifespan studies.** Sanders, C.L. Feb 1985. NTIS, PC A07/MF A01. File Number DE85009365.

In Pacific Northwest Laboratory annual report for 1984 to the DOE Office of Energy Research. Part 1. Biomedical sciences.

This project will produce data to generate a dose-response curve (and to evaluate other statistical methods that also incorporate survival time) for lung-tumor incidence in Wistar rats following inhalation of $^{239}PuO_2$ at levels producing lifetime radiation doses to the lung of < 5 to > 2000 rad. The lung clearance of ^{239}Pu is best represented by a two-exponential equation, with 78% of the initial alveolar depositions (IAD) cleared with a half-time of 19 days and 22% cleared with a half-time of 180 days. A total of 593 of 2134 exposed and 242 of 1058 sham-exposed rats have died. Among the dead rats, the percent with primary lung tumors was 71% for the 150-nCi group, 70% for the 82-nCi group, and 23% for the 32-nCi group. No lung tumors have been found in controls, and only three have been found at an IAD of < 7.5 nCi. 1 figure, 3 tables.

32331 (PNL—5500-Pt.1, pp 43-47) **Fetal and juvenile radiotoxicity.** Sikov, M.R. Feb 1985. NTIS, PC A07/MF A01. File Number DE85009365.

In Pacific Northwest Laboratory annual report for 1984 to the DOE Office of Energy Research. Part 1. Biomedical sciences.

This project is directed at obtaining detailed comparative information on the deposition, distribution, retention, and toxicity of radionuclides in the prenatal and juvenile mammal. Because quantitative data cannot necessarily be extrapolated to man, emphasis is also directed toward establishing patterns, phenomenologic interactions, and relationships which will be useful in determining appropriate exposure levels for rapidly growing infants or children and for pregnant women. Further dosimetry for an experiment to evaluate the effects of foster-rearing of newborn rats on the lifetime effects of ^{239}Pu exposure has demonstrated that most of the lifetime burden is derived from prenatal exposure and that milk contributes little in addition. Other measurements have confirmed a tentative observation that the lifetime burden in offspring is greater with near-term exposure than with exposure earlier in gestation. Additional results from a comparison of the embryotoxicity of ^{239}Pu and ^{241}Am have confirmed that, on the basis of dose administered to the dam, the former has a greater effect on the conceptus. Pilot studies indicate that ^{233}U is teratogenic, acting as a chemical rather than as a radiological teratogen. Studies with ^{239}Pu-exposed pregnant rabbits have shown that maternal distribution differs from that in rodents; concentration patterns in the placenta and membranes also differed. 4 figures, 1 table.

32332 (PNL—5500-Pt.1, pp 55-57) **Gut-related studies of radionuclide toxicity.** Sullivan, M.F. Feb 1985. NTIS, PC A07/MF A01. File Number DE85009365.

In Pacific Northwest Laboratory annual report for 1984 to the DOE Office of Energy Research. Part 1. Biomedical sciences.

The behavior of radioactive materials that may be ingested as a consequence of a reactor accident, unavoidable occupational exposure, or after release to the environment and incorporation into the food chain is investigated. Current emphasis is on evaluating hazards from ingested actinides as a function of animal age, species, nutrition, and diet, or chemicophysical state of the actinide. The authors are also concerned with the behavior of actinides that are inhaled and pass through the gastro-intestinal tract after clearance from the lungs. The radionuclides being investigated are ^{238}Pu, ^{241}Am, ^{244}Cm, ^{147}Pm, ^{109}Cd, and ^{210}Pb. 2 tables.

32333 **(REG/G—2-85-Draft) Guide for the preparation of applications for licenses for the use of sealed sources in gas chromatography devices and x-ray fluorescence analyzers. Draft.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research). Feb 1985. 22p. US Nuclear Regulatory Commission, Washington, DC 20555. File Number TI85901245.

A regulatory guide is presented to provide assistance to applicants and licensees in preparing applications for new licenses, license amendments, and license renewals for the use of sealed sources in gas chromatography devices and x-ray fluorescence analyzers. (ACR)

32334 **37-year medical follow-up of Manhattan Project Pu workers.** Voelz, G.L.; Grier, R.S.; Hempelmann, L.H. (Los Alamos National Lab., NM). *Health Physics;* **48**: No. 3, 249-259(Mar 1985).

Twenty-six male subjects, who worked with Pu during World War II under extraordinarily crude conditions, have been given medical examinations periodically over the past 37 y to identify potential health effects. Inhalation was the primary mode of the Pu exposures. Current estimates of the systemic Pu depositions in these individuals range from 2 to 95 nCi with a mean of 26 nCi. Seven individuals have depositions of 40 nCi or more, often considered the lifetime maximum permissible body burden for workers. Two individuals have died compared to 6.6 expected deaths based on US adjusted rates for white males. The causes of death were myocardial infarction and accidental trauma. Examinations completed in 1981-82 revealed no cases of cancer in the group except for a history of skin cancers in three individuals. The diseases and physical changes noted in these individuals are characteristic of a male population in their upper 50s or 60s. This study yields no evidence suggesting that adverse health effects have resulted from the 37 y of exposure to internally deposited Pu.

32335 **Identity of the photoproduct that causes lacI mutations in UV-irradiated Escherichia coli.** Lawrence, C.W.; Christensen, R.B.; Christensen, J.R. (Univ. of Rochester, NY). *Journal of Bacteriology;* **161**: No. 2, 767-768(Feb 1985). Contract AC02-76EV03490.

Estimates of the capacity of photoreactivation to act specifically on premutational lesions were obtained by conjugational transfer of an F' lac plasmid from a UV-irradiated, photoreactivated donor to a Δ(pro-lac) recipient that had been UV irradiated and allowed to induce SOS functions for 30 min. This treatment reduced the frequency of induced lacI mutations by 70 to 80%, indicating that cyclobutane dimers cause most mutations in this system.

32336 **Formation of radiation-induced DNA breaks: the ratio of double-strand breaks to single-strand breaks.** Roots, R.; Kraft, G.; Gosschalk, E. (Lawrence Berkeley Lab., CA). *International Journal of Radiation Oncology, Biology and Physics;* **11**: No. 2, 259-265(Feb 1985). Contract AC03-76SF00098.

Ionizing radiation causes the formation of strand breaks in cellular DNA, as well as other types of lesions in the chromatin of cells. Some of the earliest investigations of the molecular basis of radiation-induced damage and the implications of enzymatic repair were done by Dr. H. S. Kaplan. Because it is difficult to assay for DNA lesions in the large mammalian genome, the authors have developed a method of assaying for DNA double-strand breaks in the supercoiled nucleosome-complexed Simian virus 40 (SV40) genome, irradiated intracellularly. In this communication they present their measurements of the DNA double-strand breaks (DSBs) to single-strand breaks (SSBs) ratio obtained from the intracellularly irradiated SV40 genome. After cobalt gamma ray and X ray irradiations, this ratio is about 1/10. Their methods and results are compared with pertinent data in the literature. If the DSBs/SSBs ratio of 1/10 for cellular chromatin is correct, a substantial number of DNA double-strand breaks are formed in a mammalian cell after moderate doses (1 Gy) of radiation. The implications of different types of DNA double-strand breaks are discussed.

32337 **Precision, high dose radiotherapy: helium ion treatment of uveal melanoma.** Saunders, W.M.; Char, D.H.; Quivey, J.M.; Castro, J.R.; Chen, G.T.Y.; Collier, J.M.; Cartigny, A.; Blakely, E.A.; Lyman, J.T.; Zink, S.R. (Univ. of California, San Francisco). *International Journal of Radiation Oncology, Biology and Physics;* **11**: No. 2, 227-233(Feb 1985). (CONF-8310342—). Contract AC03-76SF00098.

From 25. annual meeting of the American Society of Therapeutic Radiologists; Los Angeles, CA, USA (3 Oct 1983).

The authors report on 75 patients with uveal melanoma who were treated by placing the Bragg peak of a helium ion beam over the tumor volume. The technique localizes the high dose region very tightly around the tumor volume. This allows critical structures, such as the optic disc and the macula, to be excluded from the high dose region as long as they are 3 to 4 mm away from the edg the tumor. Careful attention to tumor localization, treatment planning, patient immobilization and treatment verification is required. With a mean follow-up of 22 months (3 to 60 months) the authors have had only five patients with a local recurrence, all of whom were salvaged with another treatment. Pretreatment visual acuity has generally been preserved as long as the tumor edge is at least 4 mm away from the macula and optic disc. The only serious complication to date has been an 18% incidence of neovascular glaucoma in the patients treated at our highest dose level. Clinical results and details of the technique are presented to illustrate potential clinical precision in administering high dose radiotherapy with charged particles such as helium ions or protons.

32338 **Correction of a nucleotide-excision-repair mutation by human chromosome 19 in hamster-human hybrid cells.** Thompson, L.H.; Mooney, C.L.; Burkhart-Schultz, K.; Carrano, A.V.; Siciliano, M.J. (Lawrence Livermore National Lab., CA). *Somatic Cell and Molecular Genetics;* **11**: No. 1, 87-92(Jan 1985).

A UV-sensitive mutant line of CHO cells, UV20, was shown to be phenotypically corrected to resistance by fusion with human lymphocytes or fibroblasts. Only human chromosome 19 correlated with the DNA repair phenotype of resistant hybrid clones and their resistant or sensitive subclones. This study demonstrates the mapping of a human repair gene by direct selection of complementing hybrids in the presence of a DNA-damaging agent (mitomycin C).

32339 **Ultraviolet action spectra for DNA dimer induction, lethality, and mutagenesis in Escherichia coli, with emphasis on the UVB region.** Peak, M.J.; Peak, J.G.; Moehring, M.P.; Webb, R.B. (Argonne National Lab., IL (USA)). *Photochemistry and Photobiology;* **40**: No. 5, 613-620(Nov 1984).

Ultraviolet action spectra were obtained for lethality and mutagenesis (reversion to tryptophan independence) in Escherichia coli WP2s for wavelengths 254-405 nm with detailed analysis in the UVB region. Parallel chemical assay yields of pyrimidine dimers in DNA of E. coli RT4 were determined. lethality, mutagenesis and dimer induction all decreased with increasing wavelength. Between 300 and 320 nm, the mutagenesis action spectrum coincides closely with the absorption spectrum of DNA. The lethality spectrum is closely parallel to the mutagenicity spectrum. A calculation derived from the slope of the UVB spectra reveals that a 10nm shift of the solar UV spectrum to shorter wavelengths would result in a 35% increase in its mutagenic potential. At 325 nm, both biological action spectra show sharp decreases in slope. In addition, above 325 nm the spectra for lethality, mutagenicity and dimer formation diverge sharply; lethalities at these UVA wavelengths were approximately tenfold greater relative to mutagenicity than at shorter wavelengths. The relative yield of dimer formation by 365 nm radiation is intermediate between the yibits replication. The authors ask whether the increase in the dTTP/dCTP ration in mutagenized whole cells either contributes to or prolongs induced inhibition of replication. In addition they proposed that such an induced dNTP imbalance may also contribute to an increase in mutations by enhancing the probability for base-misincorporation.

32342 **DNA repair in B. subtilis: an inducible dimer specific W-reactivation system.** Fields, P.I.; Yasbin, R.E. (Pennsylvania State Univ., University Park). *Molecular and General Genetics;* **190**: 475-480(1983). Contract AC02-81ER60017.

The W-reactivation system of Bacillus subtilis repairs pyrimidine dimers in bacteriophage DNA. This inducible repair system can be activated by treatment of the bacteria with UV, alkylating agents, cross-linking agents and gamma radiation. However, bacteriophage treated with agents other than those that cause pyrimidine dimers were not repaired by this unique form of W-reactivation. In contrast, the W-reactivation system of Escherichia coli repairs a variety of damages in the bacteriophage DNA. 35 references, 4 figures.

5602 Thermal Effects

REFER ALSO TO CITATION(S) 31269, 32011

32343 **(DTH-LV—161) Why do even low air velocities cause thermal discomfort.** Lund Madsen, T. (Danmarks Tekniske Hoejskole, Lyngby. Lab. for Varmeisolering). 1984. 7p. (CONF-840803—18). NTIS (US Sales Only), PC A02/MF A01. File Number DE85750803.

From 3. international conference on indoor air quality and climate; Stockholm, Sweden (20 Aug 1984).

In this paper a hypothesis is set up in order to explain the discrepancy between the relatively high acceptable air velocities found during climate chamber tests, and the much lower acceptable velocities found under many practical circumstances. A thermal-electrical analog model of the human skin including thermal receptors has been developed. The model is based on the similarity of the mathematical equations describing thermal and electrical conduction. The air velocity field which test persons have been exposed to in a climate chamber is recorded on magnetic tape. It is now possible to impress this air velocity field on the analog model and measure the output from the thermal receptor and later to impress the constant air velocity which will cause the same mean output from the receptors. The comparison between this velocity and the actual mean air velocity measured in the climatic chamber, and the votes from the test persons form a basis for the hypothesis.

32344 **Toxic and osmotic effects of glycerol on human granulocytes.** Armitage, W.J.; Mazur, P. (Univ. of Tennessee-Oak Ridge Graduate School of Biomedical Sciences). *American Journal of Physiology;* **247**: No. 5, C383-C389(Nov 1984). Contract W-7405-ENG-26.

Human granulocytes are damaged by exposure to concentrations of glycerol as low as 0.5 M. We therefore investigated the addition of glycerol to granulocytes and its subsequent dilution under various conditions to try to distinguish between toxic and harmful osmotic effects of glycerol. The lesion caused by glycerol at 0°C was expressed as a loss of plasma membrane integrity (as visualized by fluorescein diacetate) only after incubation (≧1 h) at 37°C. This damage was not ameliorated when osmotic stress was lessened by reducing the rates of addition and dilution of glycerol to keep the computed cell volume within 80-170% of isotonic cell volume. However, when osmotic stress was reduced further by increasing the temperature of addition and dilution of glycerol from 0° to 22°C, the tolerance of the cells to 1 M glycerol increased somewhat. Reducing exposure to glycerol to 3 min or less at 0°C greatly increased survival, but this time was too short to allow glycerol to equilibrate intracellularly. Finally, the presence of extra impermeant solute (NaCl or sucrose) in the medium to reduce the equilibrium cell volume to 60% of isotonic cell volume enabled granulocytes to survive 30-min exposure to 1 M glycerol at 0°C, but cells had to remain shrunken during the 37°C incubation to prevent the loss of membrane integrity. Suspensions that contained damaged granulocytes formed aggregates when incubated at 37°C, and these aggregates were responsible for a major fraction of the observed loss in viability.

32345 **Osmotic tolerance of human granulocytes.** Armitage, W.J.; Mazur, P. (Univ. of Tennessee-Oak Ridge Graduate School of Biomedical Sciences). *American Journal of Physiology;* **247**: No. 5, C373-C381(Nov 1984). Contract W-7405-ENG-26.

Human granulocytes are injured when returned to isotonic conditions after exposure at 0°C to hyperosmotic solutions of NaCl or sucrose with osmolalities above 0.6 osmolal. The damage was expressed as a loss of membrane integrity [fluorescein diacetate (FDA) assay] only after 60-90 min incubation at 37°C. Survival after exposure to a 1.4-osmolal solution at 0°C was dependent on the extent of subsequent dilution. Dilution to below 0.6 osmolal was damaging, but cells could be returned to near-osmotic conditions provided that the solute concentration was increased again to 0.64 osmolal before the cells were incubated at 37°C. Granulocyte cell volumes were measured under various osmotic conditions by computer-assisted micrometry. The cells did not display a minimum volume but behaved as osmometers over the observed range of 0.2-1.4 osmolal. Granulocyte volume at a given osmolality was independent of whether the cells had first been exposed to a strongly hyperosmotic medium, indicating that no solute loading occurred in hyperosmotic sucrose solutions. Even though the cells did not survive sequential exposure to >0.6 osmolal solutions, subsequent return to isotonicity, and incubation at 37°C, neither cell lysis nor loss in FDA-positive cells occurred after the first two steps. This finding is not consistent with the critical-surface area-increment theory of freezing injury. The mechanism of cell injury in hyperosmotic solutions is thus not known. However, the results show that osmotic stress is potentially a major damaging factor both in the equilibration of cells with protective additives and during freezing and thawing.

5603 Chemicals Metabolism And Toxicity

REFER ALSO TO CITATION(S) 29688, 29784, 29841, 29842, 30085, 31626, 31628, 32135, 32150, 32153, 32154, 32155, 32186, 32188, 32229, 32341

32346 **(ANL/EES-TM—276) Estimating risks of lead-induced hemoglobin decrements under conditions of uncertainty: methodology, pilot judgments, and illustrative calculations.** Whitfield, R.G.; Wallsten, T.S. (Argonne National Lab., IL (USA)). Sep 1984. Contract W-31-109-ENG-38. 66p. NTIS, PC A04/MF A01; GPO Dep. File Number DE85012293.

This report focuses on probabilistic judgments about dose-response relationships between lead exposure and subsequent hemoglobin decrements. It describes a method for obtaining the judgments, representing them mathematically, and combining them with a measure of lead exposure to estimate health risks. The method is easily applied to other health effects as well. A study was performed to test a protocol for obtaining probabilistic judgments from health experts. Judgments of two pilot subjects were encoded to determine the subjects' judgmental dose-response functions for lead-induced hemoglobin decrements. Their judgments were represented mathematically (with the normal-on-log-odds function) and combined with blood-lead data (a measure of exposure to lead) from the National Health and Nutrition Examination Survey II to illustrate the estimation of health risks for US children aged 0 to 3 years. The report also discusses ways to summarize large amounts of complex risk assessment data and calculations and present them in a form understandable by and useful to decision makers. The pilot encodings and the ensuing calculations provided valuable experience that can be applied to both the planned encodings of the judgments of experts on the health effects of lead and the development of risk estimates partially based on those judgments. 4 refs., 16 figs., 12 tabs.

32347 **(CEA-R—5282) Transfer of SO_2 and effects on plants.** Angeletti, L. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)). Sep 1984. 38p. (In French). NTIS (US Sales Only), PC A03/MF A01. File Number DE85751221.

After a short review of the natural and artificial sources of sulfur and its effect on plants, the studies on the effects of SO_2 on the aerial parts of plants and on rain-plant interaction are assessed. The importance of the components of the climate on SO_2 foliar uptake is emphasized and a critical analysis is made of the methods used to measure SO_2 uptake by plants and of their results. The present scientific knowledge does not allow a realistic assessment of the amounts retained by plants, which forbids to establish dose-effect relationships, and consequently prevents any action in order to control and standardize SO_2 emissions by fossil-fueled electric power plants.

32348 **(DOE/CH/00016—T7) Anaerobic microbial transformations in subsurface environments.** Bollag, J.M.; Berry, D.F.; Chanmugathas, P. (Pennsylvania State Univ., University Park (USA). Dept. of Agronomy; Brookhaven National Lab., Upton, NY (USA)). Apr 1985. Contract AC02-76CH00016. 14p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85012790.

The first draft of a literature review article entitled, "Metabolism of Homocyclic (Benzenoid) and Heterocyclic Aromatic Compounds by Microorganisms Under Anaerobic Conditions" is completed. The article covers biodegradation of both heterocyclic and homocyclic aromatic compounds under a variety of conditions including nitrate reducing, fermentation, sulfate reducing, and methanogensis. Laboratory experiments have been designed to study the anaerobic biotransformation processes involving organic substance derived from energy residual wastes. The test compounds selected for the initial anaerobic biodegradation experiments include aniline, indole, and pyridine. A Hungate apparatus is presently in operation.

32349 **(DOE/EV/03221—81) Nature of oxygen containing radicals in radiation chemistry and photochemistry of aqueous solutions. Final progress report, July 1982-July 1983.** Czapski, G. (Hebrew Univ., Jerusalem (Israel). Dept. of Physical Chemistry). 1983. Contract AC02-76EV03221. 33p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85013327.

This report summarizes the results of research on the physical and chemical properties of ozonide and hydroperoxy radical in aqueous solutions, particularly in biological systems. The effects of the presence of copper and iron on oxygen toxicity were studied. (ACR)

32350 **(GSF-A—1/84) Trace element analytical chemistry in medicine and biology.** (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.); Arbeitsgemeinschaft der Grossforschungseinrichtungen (AGF), Bonn (Germany, F.R.)). 1984. 108p. (CONF-8404246—Absts.). NTIS (US Sales Only), PC A06/MF A01. File Number DE85752003.

From 3. international workshop on trace element analytical chemistry in medicine and biology; Neuherberg, F.R. Germany (16 Apr 1984).

The present abstract-book contains 76 abstracts of papers dealing with the analysis and content of trace elements in food, plants, animals and man, healthy or with different diseases.

32351 **(NP—5770296) Effects of sulphur dioxide on plants with special reference to biochemical and physiological responses.** Schlee, D. (Universitaets- und Landesbibliothek Sachsen-Anmhalt, Halle (German Democratic Republic)). 1982. 138p. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number DE85770296.

This bibliography contains over 1300 titles listed according to author in alphabetical order, whereby no effort has been made to include all references on this subject. The rapid increase in publications from 1960 onwards can clearly be correlated with the increase in SO_2 concentrations in the air, which at the present time amounts to some $160x10^6$ t a^{-1}. Earlier contributions largely described the biological damage caused by SO_2 whereas contemporary papers deal chiefly with modern research on the analysis of effects at the molecular and cellular level. Metabolic changes and alterations in the ultra-structure of the cell, along with photosynthetic processes, transpiration and SO_2-uptake are of primary importance in this respect.

32352 **(PNL—5434) Harvester ant bioassay for assessing hazardous chemical waste sites.** Gano, K.A.; Carlile, D.W.; Rogers, L.E. (Pacific Northwest Labs., Richland, WA (USA)). May 1985. Contract AC06-76RL01830. 88p. NTIS, PC A05/MF A01; GPO Dep. File Number DE85013031.

A technique was developed for using harvester ants, Pogonomyrmex owhyeei, in terrestrial bioassays. Procedures were developed for maintaining stock populations, handling ants, and exposing ants to toxic materials. Relative toxicities were determined by exposing ants to 10 different materials. These materials included three insecticides, Endrin, Aldrin, and Dieldrin; one herbicide, 2,4-D; three complex industrial waste residuals, wood preservative sludge, drilling fluid, and slop oil; and three heavy metals, copper zinc, and cadium. Ants were exposed in petri dishes containing soil amended with a particular toxicant. Under these test conditions, ants showed no sensitivity to the metals or 2,4-D. Ants were sensitive to the insecticides and oils in repeated tests, and relative toxicity remained consistent throughout. Aldrin was the most toxic material followed by Dieldrin, Endrin, wood preservative sludge, drilling fluid, and slop oil. 12 refs., 2 figs., 2 tabs.

32353 **(PNL—5500-Pt.1, pp 85-86) Metal-membrane interactions.** Schneider, R.P. Feb 1985. NTIS, PC A07/MF A01. File Number DE85009365.

In Pacific Northwest Laboratory annual report for 1984 to the DOE Office of Energy Research. Part 1. Biomedical sciences.

Using zinc uptake system of Neurospora crassa as a model system, the kinetics and regulation of heavy metal uptake by eukaryotic microorganisms were investigated. The authors performed experiments designed to show whether free Zn^{2+} or the zinc-citrate complex is the form recognized by the zinc-membrane receptor. These experiments showed that the affinity of the uptake system is the same for free zinc or the citrate chelate, indicating that the receptor is indifferent to the form of the metal. The system is highly specific; i.e., zinc uptake is not affected by 100-fold higher concentrations of Co, Pb, U, Ni, Ca, Mg or Fe. Uptake of Zn is inhibited by Hg and Cd, but these two metals are not taken up by the system at measurable rates.

32354 **(PNL—5500-Pt.1, pp 31-33) Cigarette smoke and plutonium.** Filipy, R.E. Feb 1985. NTIS, PC A07/MF A01. File Number DE85009365.

In Pacific Northwest Laboratory annual report for 1984 to the DOE Office of Energy Research. Part 1. Biomedical sciences.

Autoradiographic techniques with liquid photographic emulsion and cellulose nitrate track-etch film are being used to investigate the spatial distribution of inhaled plutonium in the lungs of beagle dogs exposed to cigarette smoke or to the plutonium aerosol only. More plutonium than expected was detected on the inner surfaces of bronchi, and particles were observed beneath the bronchial mucosa. 2 figures, 2 tables.

32355 **(ZfI-Mitt—77, pp 268-273) Effect of acute prenatal hypoxia on the incorporation of ^{15}N in the brain and liver protein of rats aged 6 and 11 days.** Plath, C.; Richter, I.; Heine, W. (Rostock Univ. (German Democratic Republic). Bereich Medizin); Zhukova, T.P.; Sorokina, E.G. (Akademiya Meditsinskikh Nauk SSSR, Moscow. Inst. Pediatrii). Sep 1983. NTIS (US Sales Only), PC A14/MF A01. File Number DE85780083. (CONF-8305218—Summ.).

From Recent results of /sup 15/N tracer technique in medicine symposium; Rostock, German D.R. (29 May 1983).

Studies with ^{15}N-labelled amino acids revealed, that an early and correctly balanced supply of concentrated proteins or amino acids must be available during the early neonatal period, because of the diminution of protein synthesis in the newborn, especially those having already been damaged prenatally.

32356 **Lung clearance, translocation, and acute toxicity of arsenic, beryllium, cadmium, cobalt, lead, selenium, vanadium, and ytterbium oxides following deposition in rat lung.** Rhoads, K.; Sanders, C.L. (Pacific Northwest Lab., Richland, WA). *Environmental Research;* **36**: No. 2, 359-378(Apr 1985). Contract AC06-76RL01830.

Young adult rats were exposed via inhalation or intratracheal instillation to oxides of arsenic, beryllium, cadmium, cobalt, lead, selenium, vanadium, and ytterbium. Serial necropsies were performed to assess the metal content in organs at times up to several weeks after exposure. The lung clearance varied widely for these compounds, and the times to remove 50% of the initial burden ranged from 18 min for vanadium to 400 days for beryllium. Arsenic, cadmium, lead, selenium, and vanadium were initially soluble in lung, but a small fraction (1-20%) remained there over the long term. Extrapulmonary tissues often accumulated substantial amounts of the soluble oxides, and whole-body retention was often greater for compounds that were more soluble in lung. Arsenic, selenium, and vanadium translocated to carcass and bone. Arsenic, cadmium, lead, and selenium accumulated in the liver, and the kidney retained cadmium and lead. Beryllium, cobalt and ytterbium did not deposit at any extrapulmonary site in significant amounts. In general, the aqueous solubility of these compounds was a poor predictor for behavior in vivo because of their interaction with metabolic processes. Of the metal oxides tested for acute lethality following pulmonary deposition, cadmium was most toxic, followed by selenium, vanadium, and arsenic.

32357 **L-Phenylalanine and L-tyrosine catabolism by selected Streptomyces species.** Pometto, A.L. III; Crawford, D.L. (Univ. of Idaho, Moscow). *Applied and Environmental Microbiology;* **49**: No. 3, 727-729(Mar 1985). Contract AS07-80ER10775.

L-Phenylalanine and L-tyrosine were completely catabolized through homogentisate by Streptomyces setonii 75Vi2 but only partially degraded by Streptomyces badius 252, Streptomyces sioyaensis P5, Streptomyces viridosporus T7A, and Streptomyces sp. strain V7. Intermediates of catabolism were confirmed by the thin-layer, gas, and high-pressure liquid chromatography. Homogentisate 1,2-dioxygenase was present in all cell extracts.

32358 **Sodium-sugar coupling stoichiometry in chick intestinal cells.** Kimmich, G.A.; Randles, J. (Univ. of Rochester, NY). *American Journal of Physiology;* **247**: No. 1, C74-C82(Jul 1984). Contract AC02-76EV03490.

Sodium-dependent sugar transport systems involve the function of membrane components that couple the transmembrane flow of Na^+ to the concomitant flow of certain sugar molecules. The coupling stoichiometry between Na^+ and sugar fluxes via these systems must be measured under conditions in which the membrane potential does not change due to the induction of transport or during the interval of flux measurement. This can be accomplished by utilizing gradients of highly permeant ions (NO_3^- and K^+ plus valinomycin) to create diffusion potentials of sufficient magnitude that the sugar-induced Na^+ flux does not introduce an appreciable change in the imposed potential. Under these conditions, the coupling stoichiometry for chicken intestinal cells proves to be 2 Na^+:1 sugar as reported earlier for studies performed in the absence of a membrane potential. When control of the potential is not maintained, a coupling ratio of 1:1 is observed. The stoichiometry does not change as a function of Na^+ concentration, which suggests that carrier forms with only one Na^+ bound do not contribute to the carrier-mediated Na^+ or sugar fluxes. When no potential is present, the stoichiometry is modified by the level of intracellular Na^+ and sugar in a manner indicative of a transport mechanism in which Na^+ must dissociate from the loaded carrier at the inward facing membrane surface before the sugar molecule dissociates.

32359 **Distinguishing effects of anemia and muscle iron deficiency on exercise bioenergetics in the rat.** Davies, K.J.A.; Donovan, C.M.; Refino, C.J.; Brooks, G.A.; Packer, L.; Dallman, P.R. (Univ. of California, Berkeley). *American Journal of Physiology;* **246**: No. 6, E535-E543(Jun 1984). Contract W-7405-ENG-48.

Three weeks of dietary iron deficiency in weanling rats resulted in anemia (Hb, 39 vs 14.2 g/dl in controls) and decreased oxidative capacities of skeletal muscle (as much as 90% below control values). Whole-animal maximal O_2 consumption V/sub 0_2//sub max//, measured in a brief treadmill run of progressively increasing work load, was ~50% lower for iron-deficient rats than for controls, and maximal endurance capacity (time to exhaustion in a separate treadmill run at a constant, sub- V/sub 0_2//sub max// work load) was 90% lower from iron-deficient rats than for controls. Exchange transfusion with packed erythrocytes or plasma, was used to adjust Hb to an intermediate concentration of approximately 9.5 g/dl in both iron-deficient and control rats. This procedure corrected the V/sub 0_2//sub max// of iron-deficient rats to within 15% of control values, whereas endurance capacity showed no improvement. Our experimental dissociation of V/sub 0_2//sub max/// and endurance capacity provides further evidence that V/sub 0_2//sub max// is not the sole determinant of endurance. We propose that defects in V/sub 0_2//sub max// during iron deficiency result primarily from diminished O_2 delivery, whereas decreased endurance capacity reflects impaired muscle mitochondrial function.

32360 **Effects of $CdCl_2$ on the maternal-to-fetal clearance of ^{67}Cu and placental blood flow.** Chertok, R.J.; Kullgren, B.; Burbank, D. (Oak Ridge National Lab., TN). *Proceedings of the Society for Experimental Biology and Medicine;* **176**: No. 1, 138-142(May 1984). Contract AC05-76OR00033.

Copper is an essential element while Cd is an extremely toxic heavy metal of questionable biological usefulness. Cadmium has been reported to interfere with the metabolism of Cu, be teratogenic, and decrease blood flow in the fetal placenta. Because of these reported biological interactions of Cd and Cu, this investigation was conducted to determine the effects of Cd on placental transport of ^{67}Cu and placental blood flow in the guinea pig. All guinea pigs used were 60 +/- 1 days pregnant. A placental perfusion technique was used to measure the maternal-to-fetal clearance of ^{67}Cu and ^3H_2O across the placenta. The clearance of ^3H_2O served as an indicator of placental blood flow on the maternal side of the circulation. The results indicated that an iv injection of 1 mg Cd/kg body weight resulted in an immediate increase in the clearance of ^{67}Cu which declined over the next 8 min to an elevated level compared to the extrapolated best-fit curve of control values. This iv injection of $CdCl_2$ concomitantly reduced the maternal-to-fetal clearance of ^3H_2O across the placenta. In conclusion, an acute exposure of the pregnant female to $CdCl_2$ results in an increased maternal-to-fetal clearance ^{67}Cu and a reduced placental blood flow that can alter the supply of nutrients to the developing embryo or fetus, and therefore modify normal development.

32361 **Kinetic characterization of $^{13}NH_3$ and $[^{13}N]$glutamine metabolism in rabbit heart.** Krivokapich, J.; Barrio, J.R.; Phelps, M.E.; Watanabe, C.R.; Keen, R.E.; Padgett, H.C.; Douglas, A.; Shine, K.I. (Univ. of California, Los Angeles). *American Journal of Physiology;* **246**: No. 1, H267-H273(Jan 1984). Contract AC03-76SF00012.

The isolated arterially perfused rabbit interventricular septum was used to study the effects of methionine sulfoximine (MSO) on ^{13}N-labeled ammonia ($^{13}NH_3$) and ^{13}N-labeled glutamine ($[^{13}N]$) metabolism. Tissue time-activity curves were generated from bolus injections of $^{13}NH_3$ or $[^{13}N]$gln delivered interarterially during control conditions and in the presence of MSO. The fraction of ^{13}N label retained in the tissue [EF(3)] was significantly less after a bolus of $[^{13}N]$gln than $^{13}NH_3$. MSO significantly decreased the EF(3) after a bolus of $^{13}NH_3$ or $[^{13}N]$gln. Chemical analyses using high-pressure liquid chromatography on tissue and effluent samples obtained after bolus injections of $^{13}NH_3$ and $[^{13}N]$gln with or without MSO present showed the following: 1) after a bolus of $^{13}NH_3$ or $[^{13}N]$gln the tissue ^{13}N label is predominantly in $[^{13}N]$gln at 6 min after injection, and 2) MSO significantly decreases the synthesis of $[^{13}N]$gln after an $^{13}NH_3$ bolus. Thus it would appear that the glutamine synthetase reaction is primarily responsible for the retention of the ^{13}N label from $^{13}NH_3$ as $[^{13}N]$gln in rabbit myocardium.

32362 **Mutagenicity and cytotoxicity of five antitumor ellipticines in mammalian cells and their structure-activity relationships in Salmonella.** DeMarini, D.M.; Cros, S.; Paoletti, C.; Lecointe, P.; Hsie, A.W. (Univ. of Tennessee-Oak Ridge Graduate School of Biomedical Sciences). *Cancer Research;* **43**: 3544-3552(Aug 1983). Contract W-7405-ENG-26.

The mutagenicity and cytotoxicity of five antitumor compounds (ellipticines) were investigated in the Chinese hamster ovary cell hypoxanthine-guanine phosphoribosyltransferase assay and in six strains of Salmonella. All five compounds (ellipticine, 9-

methoxyellipticine, 9-hydroxyellipticine, 9-aminoellipticine, and 2-methyl-9-hydroxyellipticinium) were cytotoxic and mutagenic in the Chinese hamster ovary cell hypoxanthine-guanine phosphoribosyltransferase assay in the presence or absence of Aroclor 1254-induced rat liver S9, and all except the last compound were mutagenic in Salmonella. Based on the reversion pattern obtained in various frame-shift and DNA repair-proficient (uvrB$^+$) or -deficient (uvrB) strains of Salmonella in the presence or absence of S9, the first three compounds appear to cause frameshift mutations by both intercalation and covalent bonding with DNA; thus, these are classified as reactive intercalators. However, 9-aminoellipticine intercalates only weakly and may instead exert its mutagenic activity primarily (or exclusively) by forming a covalent adduct with DNA. Compared to the published antitumor data obtained in mice, the results in Salmonella and Chinese hamster ovary cells suggest that the ability of ellipticine, 9-methoxyellipticine, and 9-hydroxyellipticine to intercalate with DNA, induce frame-shift mutations, and cause cell killing is associated with and may be the basis for their antitumor activity. The observation that the ellipticines are mutagenic in mammalian cells suggests that these antitumor agents may be carcinogenic.

32363 Clearance of sulfuric acid-introduced ^{35}S from the respiratory tracts of rats, guinea pigs and dogs following inhalation or instillation. Dahl, A.R.; Felicetti, S.A.; Muggenburg, B.A. (Inhalation Toxicology Research Institute, Albuquerque, NM). *Fundamental and Applied Toxicology;* **3**: 293-297(Jul-Aug 1983). Contract AC04-76EV01013.

The clearance of sulfuric acid-introduced ^{35}S from the upper and lower respiratory tracts of rats, guinea pigs and dogs was measured. Sulfuric acid was administered by instillation and by inhalation for each species. Clearance into the blood and gastrointestinal tract was measured along with determination of ^{35}S remaining at the site of administration at sacrifice. Different rates of clearance from different sites within the dog lung were indicated with rates of clearance increasing with decreasing airway diameter. Half-times of clearance from all sites in the lung and for all species were from 2-9 min. There appeared to be some species differences, with clearance for dogs being slower than for guinea pigs, which was slower than for rats. Upper respiratory tract clearance was much slower than for lung and may not have been primarily by way of the blood. The data indicate that the clearance of sulfuric acid-introduced ^{35}S in vivo is faster than previous studies in isolated perfused lungs had indicated. The results may be general for water soluble, ionized chemical species. 13 references, 3 figures, 1 table.

32364 Extent of histone modifications and H1^0 content during cell cycle progression in the presence of butyrate. D'Anna, J.A.; Gurley, L.R.; Tobey, R.A. (Los Alamos National Lab., NM). *Experimental Cell Research;* **147**: 407-417(1983).

The effects of butyrate upon the extents of phosphorylation of histones H1 and H1^0 during cell-cycle progression have been investigated. Chinese hamster (line CHO) cells were synchronized in early S phase and released into medium containing 0 or 15 mM butyrate to resume cell-cycle traverse into G1 of the next cell cycle. Cells were also mechanically selected from monolayer cultures grown in the presence of colcemid and 0 or 15 mM butyrate to obtain >98% pure populations of metaphase cells. Although cell cycle progression is altered by butyrate, electrophoretic patterns of histones H1, H1^0, H3, and H4 indicate that butyrate has little, if any, effect on the extents of H1 and H1^0 phosphorylation during the cell cycle or the mitotic-specific phosphorylation of histone H3. Butyrate does, however, inhibit removal of extraordinary levels of histone H4 acetylation (hyperacetylation) during metaphase, and it appears to cause an increase in the content of H1^0 in chromatin during the S or G2 phases of the cell cycle. 38 references, 4 figures, 1 table.

32365 TPA induces simultaneous alterations in the synthesis and organization of vimentin. Laszlo, A.; Bissell, M.J. (Lawrence Berkeley Laboratory, CA). *Experimental Cell Research;* **148**: 221-234(1983). Contract AC03-76SF00098.

The authors have found an increased rate of vimentin synthesis in TPA-treated chicken embryonic-fibroblasts, as shown by two-dimensional electrophoretic separation of newly synthesized polypeptides. The capacity of TPA to elicit this effect correlated with its activity as a tumor promoter. Treatment with TPA also altered the organization of the vimentin-containing intermediate filaments, as revealed by immunofluorescence. Treatments which inhibited the TPA-induced rearrangements of vimentin filaments did not prevent the increase in the rate of vimentin synthesis, indicating that gross alterations in cytoskeletal organization were not the immediate cause of the altered vimentin synthesis. On the other hand, alterations in the rate of vimentin synthesis may be a necessary, but not sufficient condition for alterations in vimentin filament organization. TPA as a positive modulator of vimentin synthesis may serve as a useful probe for an eventual understanding of the dynamics of the mechanisms that control the assembly and organization of vimentin filaments. 35 references, 5 figures, 2 tables.

32366 Specific gene mutations in L5178Y cells in culture: a report of the US Environmental Protection Agency gene-tox program. Clive, D.; McCuen, R.; Spector, J.F.S.; Piper, C.; Mavournin, K.H. (Oak Ridge National Lab., TN). *Mutation Research;* **115**: 225-251(1983). Contract W-7405-ENG-26.

The predominant test system uses a near-diploid L5178Y mouse lymphoma cell line and is based on the quantitation of forward mutations occurring at the heterozygous thymidine kinase (TK) locus. (Other markers, such as ouabain- or methothrexate-resistance and alanine independence, in other L5178Y mouse lymphoma cells were also examined, but our criteria for the acceptability of data or the paucity of data considerably reduced the value of these mutagenesis test systems to this study). The biochemical basis for the L5178Y/TK/sup +/-/ assay depends on the ability of TK-competent cells to phosphorylate 5-bromo-2-deoxyuridine or trifluorothymidine. The phosphorylated product or its metabolites kill these cells, thus, medium containing 5-bromo-2-deoxyuridine or trifluorothymidine is capable of selecting for cells that are lacking the TK enzyme (TK/sup -/-/). TK/sup -/-/ cells eventually give rise to a bimodal distribution of colony sizes. The relative proportion of small and large colonies appears to be characteristic of the mutagen, its dose, and the length of the expression period. A total of 108 references were reviewed and 48 chemical agents were evaluated. Of these, in vivo carcinogenicity data existed for 44 and covered a wide variety of chemical classes (43 compounds) and a complex mixture. In this system, 39 agents were positive, 1 was negative, and 4 yielded inconclusive results. The 44 test substances evaluated were insufficient to single out agents or agent classes for which the assay was particularly well suited; however, with the exception of thymidine analogs, the system seems to be versatile. Thus the assay is of value in the battery approach to mutagenicity/carcinogenicity screening. 43 references, 9 tables.

32367 Genetics and specificity of the constitutive excision repair system of Bacillus subtilis. Friedman, B.M.; Yasbin, R.E. (Univ. of Rochester, NY). *Molecular and General Genetics;* **190**: 481-486(1983). Contract AC02-81ER60017.

An isogenic set of DNA repair-proficient and -deficient strains of B. subtilis, cured of all prophages, were constructed and analyzed for their sensitivities to selected mutagens. The results demonstrated that the lethal damage caused by ultraviolet (UV) radiation and by 4-nitroquinoline-1-oxide (4NQO) were repaired by the bacterial excision and/or recombination repair systems. In contrast, the lethal damages caused by ethyl methane sulfonate (MMS) were removed from the DNA by the recombination repair system of the bacteria, and not by the excision repair system. Significantly, the bacteria required both a functional recombination repair system and a functional excision repair system in order to remove the DNA damage caused by the bifunctional alkylating agent mitomycin C (MC). 43 references, 5 figures, 2 tables.

32368 Genotoxicity of tobacco smoke and tobacco smoke condensate. DeMarini, D.M. (Oak Ridge National Lab., TN). *Mutation Research;* **114**: 59-89(1983). Contract W-7405-ENG-26.

An attempt is made to review the types of genetic effects that are induced by tobacco smoke and by the particulate matter of cigarette smoke condensate. Published reports on the mutagenicity of cigarette smoke condensate and cigarette smoke in Salmonella are reviewed. Only a few papers have been published on the genetic toxicity of cigarette smoke in lower eukaryotes such as yeast and Neurospora. Cigarette smoke has been shown to cause sister-chromatid exchange in cells, including Salmonella, and abnormal sperm morphology in mice and humans. The epidemiology of tobacco-related diseases is discussed. 148 references, 1 table.

32369 **Influence of ethanol and methanol gasoline blends on the mutagenicity of particulate exhaust extracts.** Clark, C.R.; Dutcher, J.S.; McClellan, R.O.; Naman, T.M.; Seizinger, D.E. (Inhalation Toxicology Research Institute, Albuquerque, NM). *Archives of Environmental Contamination and Toxicology;* **12**: 311-317(1983). Contract AC04-76EV01013.

The Salmonella mutagenicity test was used to evaluate the influence of alcohol fuel extenders on the genetic toxicity of particulate exhaust extracts. Four spark-ignition engine equipped vehicles were operated on gasoline alone, 10% blends of ethanol or methanol in gasoline, and a commercially available gasohol. Dichloromethane extracts of the exhaust particles from all tests were mutagenic in Salmonella typhimurium strains TA 100 and TA 98. The extracts were less mutagenic in the nitroreductase deficient strains TA 98NR and TA98DNPR suggesting that nitro substituted polycyclic aromatic hydrocarbons may be responsible for part of the mutagenicity. In all the alcohol blended fuel tests, the mass of particle associated organics emitted from the exhaust was lower than that observed during the control tests using gasoline alone. Thus, in most cases, estimates of the emission of mutagenic combustion products from the exhaust were lower in the alcohol blend tests. 21 references, 5 tables.

32370 **Simulated acidic precipitation causes direct injury to vegetation.** Shriner, D.S. (Oak Ridge National Lab., TN). *Proceedings of the American Phytopathological Society;* **1**: 112(1975). (CONF-750616—).

From Annual meeting of the air pollution control association; Boston, MA, USA (16 Jun 1975).

Seedlings of Pinus strobus, Quercus phellos, Phaseolus vulgaris and Glycine max were exposed to a simulated sulfuric acid rain (pH 3.2) in the greenhouse or field. Seedlings of Pinus taeda were exposed to rain of pH 1.9 to 6.1. All plants showed yellow or brown necrotic zones at pH 3.2 or lower. Field exposure of white pine for 2 months to 2-4 cm of pH 3.2 rain per week caused browning of all second year needles. The kidney bean leaves developed necrotic spots (1-2 mm) on 15% to 40% of leaf after as little as three 0.6 cm, pH 3.2 rain applications. The soybean and oak developed similar symptoms of equal severity under like treatment. A single (40 minute) application of pH 1.9 to 2.7 rain induced random needle injury on the loblolly pine.

5604 Other Environmental Pollutant Effects

REFER ALSO TO CITATION(S) 30247, 30248, 30251, 30252

32371 **(DOE/EV/10566—T1) Mechanisms of mutagenesis: analysis through the use of alcohol dehydrogenase in Drosophila. Progress report, February 1984-January 1985.** Sofer, W.H. (Rutgers--the State Univ., Piscataway, NJ (USA). Waksman Inst. of Microbiology). 1985. Contract AC02-81EV10566. 5p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85005702.

A technique was developed for somatic transformation, making it possible to inject embryos with ADH genes in a variety of forms. A selection procedure was developed to chemically select strains of flies that are lacking beta - galactosidase activity. Two strains of Adh-negative flies whose lesions were generated with formaldehyde were characterized with respect to the ADH protein they manufacture, the rate at which they synthesize ADH, and the nature of the ADH mNRNA they make. (ACR)

32372 **(DOE/RA/50219—T4) Effects of 60 Hz electric fields on operant and social stress behaviors of nonhuman primates. Project technical status report, February 16, 1985-April 12, 1985.** Rogers, W.R. (Southwest Research Inst., San Antonio, TX (USA)). 19 Apr 1985. Contract AC02-80RA50219. 33p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85011992.

Objective was to investigate possible behavioral effects of exposure to high-intensity 60-Hz electric fields. Four projects are being conducted: aversive sensory character of exposure to fields, threshold intensity for detection of fields, chronic exposure effects on performance of two operant tasks, and observation of behavior of social groups under chronic exposure. Electric field testing with animals has begun. Behavioral testing had to be suspended in order to repair cages and suppress corona, and to conduct engineering tests. (DLC)

32373 **(EPRI-EA—3898) Effects of high-voltage transmission lines on honeybees.** Greenberg, B.; Bindokas, V.P.; Gauger, J.R. (Bioconcern, Inc., Chicago, IL (USA); IIT Research Inst., Chicago, IL (USA)). May 1985. 72p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920668.

When shielded and exposed colonies were placed at incremental distances at a right angle from a 760-kV transmission line different thresholds for biologic effects were obtained. Hive exposures were controlled (E-field: 7, 5.5, 4.1, 1.8, and 0.65 to 0.85 kV/m) by variable height current collectors; shielded hives under the line behave normally. Exposure to 7 kV/m can produce the following sequence of events: (1) increased motor activity and transient hive temperature increase; (2) abnormal propolization; (3) retarded hive weight gain; (4) excess queen cell production with queen loss; (5) reduction of sealed brood area; and (6) poor winter survival. No biological effects were detected below 4.1 kV/m, thus the "biological effects corridor" is limited to approximately 23 m beyond a ground projection of each outer phase wire. Hive architecture enhances E-fields and creates shock hazards for bees. Intra-hive E-fields (15 to 100+ kV/m) were measured with a displacement current sensor and fiber optic telemetry link. Step-potential-induced currents up to 0.5 uA were measured with a bee model in hives at 7 kV/m. To investigate further the role of shock versus electric field exposure the study was continued to develop hive entrance extensions (porches), which produce controlled bee exposure to E-field or shock, and to test the feasibility of using these porches in such a study. Biological effects (e.g., abnormal propolization, retarded hive weight, queen loss) found in colonies with total-hive exposure were produced by entrance-only exposure of adult bees. We now have an exposure system in which E-field and shock can be separately controlled to reproduce the biological effects. 10 refs.

32374 (PNL—5500-Pt.1, pp 79-81) **Biological effects of magnetic fields.** Kelman, B.J. Feb 1985. NTIS, PC A07/MF A01. File Number DE85009365.

In Pacific Northwest Laboratory annual report for 1984 to the DOE Office of Energy Research. Part 1. Biomedical sciences.

The scope of this project is best understood within the historical context of previously completed work. The objective has been to evaluate the effects of magnetic fields on a variety of biological systems. These systems have included dominant lethal studies in mice, prenatal development in rats, fertilization and embryonic development in trout, synthetic membranes, and long-term exposure of mice. The first controlled life-time study of mice exposed to a strong magnetic field (1 tesla) concluded this year. The study was carried out in a unique facility which permitted exposure and sham-exposure of animals under nearly identical conditions. No pattern of changes related to exposure was clearly identified in this study; several individual measurements were statistically significant and will require some further analysis to determine whether they are related to exposure.

32375 (ZfI-Mitt—77, pp 280-288) **Evaluation of the protein catabolism following deep burns by means of ^{15}N tracer technique.** Pietsch, G. (Karl-Marx-Universitaet, Leipzig (German Democratic Republic). Bereich Medizin); Czarnetzki, H.D. (Rostock Univ. (German Democratic Republic). Bereich Medizin); Faust, H.; Jung, K. (Akademie der Wissenschaften der DDR, Leipzig. Zentralinstitut fuer Isotopen- und Strahlenforschung). Sep 1983. (In German). NTIS (US Sales Only), PC A14/MF A01. File Number DE85780083. (CONF-8305218—Summ.).

From Recent results of /sup 15/N tracer technique in medicine symposium; Rostock, German D.R. (29 May 1983).

In pigs with experimental severe burns the catabolism of proteins was determined by measuring the total cumulative ^{15}N excretion, the cumulative ^{15}N-urea excretion and the ^{15}N concentration of the serum.

57 HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 31477

32376 (AD-P—004490/9/XAB) Personnel protection equipment for use with laser chemicals. Smith, I.D.; Roepke, J. (National Aeronautics and Space Administration, Las Cruces, NM (USA). White Sands Test Facility). Aug 1984. 11p. NTIS, PC A02/MF A01.

This article is from JANNAF (Joint Army-Navy-NASA-Air Force) Safety and Environmental Protection Subcommittee Meeting (1984) Held at Las Cruces, New Mexico on 7-11 May 1984, AD-B086 924L, p299-309.

The NASA White Sands Test facility (WSTF) recently built the fluid distribution system for the Army's High Energy Laser System Test Facility (HELSTF). As part of the effort, WSTF personnel were required to activate the fluorine system. To insure adequate personnel protection during the fluorine system activation, a project was undertaken to evaluate and qualify personnel protection equipment to be used during the activation (passivation) activity. Previous work in the late 60's and early 70's showed that very few materials were totally satisfactory for use with fluorine. Little if any work has been done to measure the degree of protection afforded against either fluorine gas or hydrofluoric acid (HF), the principal residual reactive material. Two general types of tests were conducted to evaluate materials. These were (1) fluorine and HF gas permeation tests, and (2) high-velocity fluorine gas-impingement tests. The gas permeation tests were designed to exposure one side of the material to the gas at concentrations of up to 27% F2 or 1.5% HF in designed to expose one side of the material to the gas at concentrations of up to 27% F2 or 1.5% HF in GN2 with a gas purge on the opposite side leading to the detection system. The tests showed that all of the materials tested which included ILC Dover Chloropel, glove materials - Neoprene, Viton, leather, butyl rubber, face shield materials, etc., where neither permeated by HF at a 1200 ppm level nor by F2 in GN2 at concentrations as high as 27% by volume. The gas-impingement tests were designed to represent a high-pressure gas leak or the cracking of a B-nut on a system containing residual fluorine gas.

32377 (DOE/ER—0193/1) Health physics/radiation protection enrollments and degrees, 1984. (Oak Ridge Associated Universities, Inc., TN (USA)). Mar 1985. Contract AC05-76OR00033. 61p. NTIS, PC A04/MF A01 - GPO; GPO Dep. File Number TI85011032.

The 1984 health physics survey was sent to 68 institutions. Sixty-two of them reported data from active programs. Total enrollment in undergraduate and graduate health physics or radiation protection programs increased in the fall of 1984 by 13% over 1983. Undergraduate enrollment rose by 5% to 400, and graduate enrollment increased by 22% to 805. The number of bachelor's degrees awarded in 1984 increased by 7% over 1983 to 146, master's degree awards increased by 11% to 181, and doctoral degrees increased by 14% to 50. 29% of bachelor's graduates intended to continue their studies. The largest employer of bachelor's and doctoral degree graduates was medical facilities; and at the master's level, nuclear utilities represented the largest employer. The second largest employer of bachelor's was nuclear utilities, of master's was medical facilities, and of doctorates was US academic institutions. Foreign national enrollment at the undergraduate level remained about the same as 1983. Statistics are also given for women and minorities, and regional distribution.

32378 (DOE/PE/17056—T3) Fire protection review revisit No. 2, Argonne National Laboratory, Argonne, Illinois. Dobson, P.H.; Earley, M.W.; Mattern, L.J. (Factory Mutual Research Corp., Norwood, MA (USA)). May 1985. Contract AC01-84PE17056. 91p. NTIS, PC A05/MF A01; GPO Dep. File Number DE85013245.

A fire protection survey was conducted at Argonne National Laboratory on April 1-5, 8-12, and April 29-May 2, 1985. The purpose was to review the facility fire protection program and to make recommendations or identify areas according to criteria established by the Department of Energy. There has been a substantial improvement in fire protection at this laboratory since the 1977 audit. Numerous areas which were previously provided with detection systems only have since been provided with automatic sprinkler protection. The following basic fire protection features are not properly controlled: (1) resealing wall and floor penetrations between fire areas after installation of services; (2) cutting and welding; and (3) housekeeping. The present Fire Department manpower level appears adequate to control a "routine" fire. Their ability to adequately handle a high-challenge fire, or one involving injuries to personnel or fire spread beyond the initial fire area is doubtful.

32379 (LMF—113, pp 323-326) Mixtures of toxic agents and the risk of health effects. Seiler, F.A. Dec 1984. NTIS, PC A23/MF A01. File Number DE85009283.

In Inhalation Toxicology Research Institute annual report, October 1, 1983-September 30, 1984.

A mathematical description is given for the risk of health effects caused by combinations of insults. The approach is completely phenomenological and has no built-in restrictions due to theories concerning the etiology of the health effect. It is restricted only by the empirical set of algebraic forms selected for the cause-effect relationship between exposure parameters and the risks incurred. Examples are given for a special case of low-risk cause-effect functions that depend on a power of dose.

32380 (PB—85-180396/XAB) Report on electrocutions, electric shock, and electric burn injuries involving consumer products. final report. (Safety Sciences, San Diego, CA (USA)). Sep 1984. 247p. (F—8324). NTIS, PC A11/MF A01.

See also PB85-180404.

This report provides direction to a project to reduce the number of electrocution, electric shock and electric burn injuries. The first section uses CPSC data to rank the consumer products involved in these accidents on the basis of frequency, severity, and number of products in use. It also analyzes demographic and accident characteristics. The second section contains a technical review of accidents occurring in eight product groups: Portable Power Tools; Welders, Battery Chargers and Inverters; Personal Hygiene Products; Entertainment Products; Lawn and Garden Tools; Installed Stoves, Ranges and Cook Tops; Refrigerators and Freezers; and Fans. This section also includes a review of the relevant Underwriters Laboratories (UL) standards and suggestions for potential action to reduce the accidents involving these eight product groups.

32381 (PB—85-180404/XAB) Report on electrocutions, electric shock, and electric-burn injuries involving consumer products. Appendices. (Safety Sciences, San Diego, CA (USA)). Sep 1984. 406p. (F—8324-APP). NTIS, PC A18/MF A01.

See also PB85-180396; Portions of this document are not fully legible.

This report contains the following appendices: Description of data bases; Overall distribution of the data by data base and product category (scope); Generic products and product codes; NEISS cross tabulations (frequency counts); FRASE coded case summaries; Product frequency by data base (all cases); Products ranked by frequency for each data base (all cases); Products ranked by frequency for each data base (in scope cases only).

58 GEOSCIENCES

5801 Geology And Hydrology

REFER ALSO TO CITATION(S) 29691, 29952, 29953, 29961, 29963, 29967, 29968, 29969, 29971, 29972, 29989, 29991, 30017, 30019, 32405

32382 (AERE-G—3226) Mathematical modelling of fracture hydrology. Progress report January-June 1984. Rae, J.; Hodgkinson, D.P.; Robinson, P.C.; Lever, D.A. (UKAEA Atomic Energy Research Establishment, Harwell. Theoretical Physics Div.). Oct 1984. 8p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85701515.

This progress report contains notes on four aspects of hydrological modelling. The first three describe the development of transport models for solute moving with groundwater in fractured rock and the application of the models to field experiments in Cornwall, UK and Chalk River, Canada. The fourth section describes network models which have been used to estimate hydrodynamic dispersion and are in process of being extended to three dimensional systems.

32383 (CBPF-NF—003/83) Archaeological dating by thermoluminescence: a review. Poupeau, G. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1983. 57p. (In French). NTIS (US Sales Only), PC A04/MF A01. File Number DE85701449.

A review of the thermoluminescence applications to the archaeological dating is presented. The physical principles used in this method are stressed.

32384 (CBPF-NF—004/83) Thermoluminescence dating of burnt cherts from the Alice Boer site (Brazil). Beltrao, M.daC.M.C.; Enriquez, C.R.; Danon, J.; Zuleta, E.; Poupeau, G. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). Jan 1983. 33p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85701450.

More than 40 culturally burnt cherts from the Alice Boer site near Rio Claro, Sao Paulo State, have been studied by thermoluminescence (TL). Nine of these were found to be sufficiently heated by early man to reset the TL clock to zero and thereby be suitable for TL dating. These cherts define, for the upper half of the uppermost cultural layer (layer III), a time scale for the presence of man from 2,220 to 11,000 years. This time range is in essential agreement with the geological-paleoclimatological age estimate for the end of deposition of this layer, as well as with radiocarbon dates. In particular, it lends support to a radiocarbon age of 14,000 BP for a deeper level. The overall geochronologic results are not in contradiction with earlier statements that the deepest cultural layer (layer V) at Alice Boer might have been deposited at least 20,000 years ago.

32385 (DOE/ER/60182—1) Remote sensing of hydrologic transport processes using spot simulation data. Final report, August 1, 1983-April 30, 1985. Gardner, T.W.; Petersen, G.W.; Connors, K.F.; Baumer, G.M. (Pennsylvania State Univ., University Park (USA). Office of Remote Sensing of Earth Resources). Apr 1985. Contract AC02-83ER60182. 125p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE85012412.

The objective was to make a preliminary evaluation of the utility of the next generation of high resolution, digital satellite imagery to characterize surface hydrology and geomorphology in both arid and humid regions. The data set was generated in a program that simulated data from a new French satellite, SPOT, scheduled for launch in 1985. The simulated data has three multispectral (MS) bands (0.50 to 0.59μm, 0.61 to 0.69μm, and 0.79 to 0.89μm) with 20m ground resolution and a panchromatic band (0.51 to 0.73μm) with 10m ground resolution. Resolution of the SPOT system allows for landscape classification at level III and occasionally level IV across distinctly different climatic zones and in areas disturbed by different types of energy exploitation. Ten features are distinguished on the semiarid site. For the humid-temperature site six classes of disturbed land are distinguished whereas only two classes are generally distinguishable with LANDSAT-3 data. Given the SPOT feature recognition and the extensive data base on Quaternary history and rates of surficial geomorphic processes for the two study sites in the San Juan Basin of northwestern New Mexico and the Bituminous Coal Fields of west central Pennsylvania, it was possible to recognize and classify critical components of the hydrologic system as well as landscape stability. These component maps include: (1) infiltration/potential runoff rate maps; (2) groundwater recharge/discharge site maps; (3) landscape stability maps; and (4) fluvial erosion intensity maps. Eight analytic techniques, including manual interpretation of 4 types of analog imagery (color composite, Eigen image, Intensity-Hue-Saturation image, and band ratio image) and 4 types of statistical analyses of digital imagery (unsupervised and supervised Euclidean distance, nonparametric linear discriminate analysis, and edge enhancement) are evaluated. 29 figs., 19 tabs.

32386 (ENPU—82-2) Regional geophysics of the Cheviot area. Lee, M.K. (Institute of Geological Sciences, Harwell (UK). Environmental Protection Unit). Jan 1982. 47p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85701045.

Regional gravity and aeromagnetic data have been used to investigate the three dimensional structure of the Cheviot igneous complex and surrounding sedimentary formations. The Bouguer Gravity Anomaly map is dominated by a large negative anomaly of -19 mgals centred over the Cheviot granite. In the surrounding area additional negative anomalies due to low density andesitic and rhyolitic lavas, and to Devonian and Lower Carboniferous sediments interfere and overlap with the anomaly due to the granite. The field due to the granite has been separated from that due to the near surface formations and interpreted in terms of a body which reaches the surface over the central part of the mapped granite outcrop and extends to a depth of about 9 km. The density of the body corresponds roughly to that of the central acid phases of the outcrop. The contacts slope outwards beneath the denser marginal granite to reach a diameter of about 35 km at 9 km depth. The aeromagnetic anomaly map is dominated by a large (400 nT) positive anomaly over the highly magnetic marginal granite and metamorphosed lavas, with a low over the weakly magnetised central granite. The results are discussed.

32387 (ENPU—82-16) Geology of the Northern part of the Strath Ossian Granite, Scotland. Henderson, W.G. (Institute of Geological Sciences, Harwell (UK). Environmental Protection Unit). Dec 1982. 22p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85701044.

The Strath Ossian Granite is made up of granodiorite, dark, variable 'granodiorites' interpreted as mobilised diorite or basic material, appinite and porphyritic granodiorite. Huge rafts of psammitic metasediments occur within the mass and three fracture-zones and numerous dykes, dominantly of porphyrite, cut across it in a north-easterly direction. Granite emplacement may have occurred in stages, early batches being xenolith-rich and later ones xenolith-poor. New batches were intruded centrally, which created strong radial stresses, sufficiently strong to make room for the intrusion by forcing the metasedimentary country rocks downwards and aside.

32388 (IS-EMRRI—19, pp 13-28) Geochemistry of sulfate evaporites in Iowa. Hansen, K.S.; Richardson, S.M. Dec 1983. NTIS, PC A07/MF A01. File Number DE85011356.

In Iowa State Mining and Mineral Resources Research Institute. Final report, July 1, 1982-September 30, 1983.

Much attention has been given to structural, stratigraphic, and lithologic features of Iowa evaporites in earlier, similar studies; however, to date, no systematic baseline survey of the chemistry of these evaporites has been conducted. Such a survey, useful as an exploratory tool and a means of interpreting the depositional paleoenvironment of the region, was completed this past year. It was found that the stable isotopes of oxygen and sulfur are fractionated among dissolved and solid phases in marine environments by processes which vary in their efficiencies as functions of temperature, salinity, and biological activity. Ideally, if the variables could be separated and evaluated independently, one could gain much valuable information about an evaporite's depositional environment by examining stable isotopic patterns in a particular geologic formation.

32389 **(LBL—17473) Studies in thermo-hydro-chemical transport in porous and fractured media.** Tsang, C.F. (Lawrence Berkeley Lab., CA (USA)). May 1984. Contract AC03-76SF00098. 12p. (CONF-8405144—4). NTIS, PC A02/MF A01; GPO Dep. File Number DE85012555.

From International groundwater symposium; Montreal, Quebec, Canada (21 May 1984).

Recent interests in the transport of toxic chemicals or radionuclides in subsurface formation raise the question of the role of processes involving the interplay of fluid flow, chemical interaction and thermal effects. The present paper reviews three examples of recent studies at Lawrence Berkeley Laboratory in this area, based on numerical modeling with a code called CPT. It is a three-dimensional chemical parcel model with a fully coupled heat and mass transport formulation for porous-fractured media with complex geometries. The three examples are: (1) injection and production of a denser cold fluid into a geothermal reservoir; (2) solute transport in a two-layered aquifer; and (3) solute transport in an aquifer with a horizontal fractured zone. The studies show a number of interesting features which may be of interest to the interpretation of field data. 4 refs., 5 figs., 3 tabs.

32390 **(PER—81) Symposium for researchers in nuclear geology - program abstracts and newsletter.** Brynard, H.J. (Nuclear Development Corp. of South Africa (Pty.) Ltd., Pelindaba, Pretoria). Jan 1984. 57p. (CONF-8311245—Absts.). NTIS (US Sales Only), PC A04/MF A01. File Number DE85780942.

From Symposium for researchers in nuclear geology; Pretoria, South Africa (23 Nov 1983).

Individual papers are indexed separately.

32391 **(SKBF-KBS-TR—83-51) GWHRT - A finite element solution to the coupled ground water flow and heat transport problem in three dimensions.** Grundfelt, B. (Swedish Nuclear Fuel Supply Co., Stockholm. Div. KBS). May 1983. 40p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85701228.

A program package for modelling ground water flow with the Finite Element Method (FEM) is presented. The package, that comprises programs for pre- and postprocessing data for the FEM-model, has been extensively used together with the GWHRT-model developed by Roger Thunvik. Thunviks hydraulic model is one-, two- or three-dimensional. It solves the ground water pressure distribution and the temperature distribution in the modelled domain using the Finite Element Method. Also saturated/unsaturated flow can be modelled. The calculations performed in the KBS-3 study are three-dimensional steady state calculations for isothermal conditions. Such a calculation typically involves the following steps: - Generation of the finite element mesh. - Assigning boundary conditions and material properties to the domain. - Solving for the hydraulic pressure distribution. - Checking the results. - Presenting the results. In the program package HYPAC these steps are implemented. This report deals mainly with the type of calculations made in the KBS-3 study although the program package in principal can handle also other types of calculations like for instance transient saturated-unsaturated flow.

32392 **(USGS—474-319) Lithologic logs of selected exploratory and emplacement drill holes in areas 9 and 10, Nevada Test Site.** Quinlivan, W.D.; Sharps, J.A.; Ohl, J.P.; Blackmon, P.D. (Geological Survey, Denver, CO (USA)). Jun 1985. Contract AI08-76DP00474. 68p. NTIS, PC A04/MF A01; GPO Dep. File Number DE85013263.

This report is a compilation of lithologic logs of 28 exploratory and emplacement holes in northeast Yucca Flat, Nevada Test Site, Nye County, Nevada, with emphasis on Quaternary alluvium and Tertiary volcanic units. An index map showing drill hole locations is included. 2 figs., 1 tab.

32393 **(USGS-OFR—85-47) Uranium-series dating of secondary carbonate and silica precipitates relating to fault movements in the Nevada Test Site region and of caliche and travertine samples from the Amargosa Desert.** Szabo, B.J.; O'Malley, P.A. (Geological Survey, Denver, CO (USA)). 1985. Contract AI08-78ET44802. 15p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85013083.

Fault associated secondary carbonate and opal samples from the Nevada Test Site area together with travertine samples from the Amargosa Desert were dated by the uranium-series disequilibrium method. Analyses of secondary carbonate samples from Yucca Mountain and from Crater and Yucca Flats yielded minimum ages for the last significant displacements of associated faults between 27,000 and 219,000 years. Dating results of an opaline carbonate rock sample from a fault on the east side of Yucca Mountain indicate that the age of the deposit is greater than 360,000 years. Two dates of travertine vein samples show that spring discharge was occurring before about 360,000 years ago in the Kinney area of the Amargosa Desert. Ages obtained for travertine laminae from the Furnace Creek Wash area suggest that significant movement along this low-angle fault occurred more than 132,000 years ago. 5 refs., 1 fig., 4 tabs.

5802 Geophysics

REFER ALSO TO CITATION(S) 29811, 29991, 30581, 30643, 30902, 32386

32394 **(CEA-CONF—7538) Assessment of seismic hazard for NNP sites in France analysis of several aftershocks of November 8, 1983, Liege earthquake.** Mohammadioun, B.; Mohammadioun, G.; Bresson, A. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete). Mar 1984. 19p. (CONF-8403180—1; DAS—80). NTIS (US Sales Only), PC A02/MF A01. File Number DE85751317.

From OTAN conference on seismic activity in Western Europe; Brussels, Belgium (20 Mar 1984).

Current French practice for assessing seismic hazard on the sites of nuclear facilities is outlined. The procedure calls for as rich and varied an assortment of actual earthquake recordings as can be procured, including earthquakes in France itself and in nearby countries, recorded by the CEA/IPSN's own staff. Following the November 8, 1983, Liege earthquake, suitably equipped, temporary recording stations were set up in the epicentral area in order to record its aftershocks. Ground motion time histories and response spectra were computed for several of these, and a quality factor Q was derived from these data for the most superficial sedimentary layers of the area. The values obtained show reasonable agreement with ones found for similar materials in other regions.

32395 **(INS-R—308) Evaluation of the alpha-track method of geothermal prospecting.** Whitehead, N.E. (Department of Scientific and Industrial Research, Lower Hutt (New Zealand). Inst. of Nuclear Sciences). Sep 1982. 4p. (DSIR-GC—NEW5). NTIS (US Sales Only), PC A02/MF A01. File Number DE85701460.

Notes on a workshop, held 30 August 1982, at the Geothermal Institute, Auckland.

A discussion between N.E. Whitehead, A. Koga, M. Cox and S. Taguchi, on evaluation of the alpha-track method of geothermal prospecting concluded that final evaluation of the method must await extensive drilling in fields where the method has been used. The local lithology is very important, and produces different backgrounds which must be allowed for. Various work has now shown some overall correlation between radon measurements and 300 m temperatures; radon and aeromagnetic surveys; radon surveys; radon and low sensitivity; and radon and self-potential measurements. Overall high zones of radon are not seen in all locations, but mainly in regions of high permeability, or near faults or shatter zones.

32396 **(N—85-17383) Seismic waves.** De, S. (National Research Inst., Bankura (India)). Nov 1984. 22p. SVIC, Code 5804, Naval Research Lab., Washington, DC 20375.

In Shock and Vibration Information Center, the shock and vibration digest, Vol. 16, No. 11, 3-24 p. (N—85-17382 08-39).

Various aspects of the propagation of elastic waves on Earth were examined. Mathematical methods, waves due to explosion and oscillation of the Earth, seismic prospecting, seismic risk, ground motion and structures, and mechanisms and prediction of earthquakes are discussed.

32397 (PER—81, pp 37-39) **Review of recent developments in radiometric calibration facilities.** Corner, B. (University of the Witwatersrand, Johannesburg (South Africa). Bernard Price Inst. of Geophysical Research). Jan 1984. NTIS (US Sales Only), PC A04/MF A01. File Number DE85780942. (CONF-8311245—Absts.).

From Symposium for researchers in nuclear geology; Pretoria, South Africa (23 Nov 1983).

Two new developments concerning radiometric calibration facilities are described in this presentation. The first is the result of the international programme for the monitoring and cross-reference of existing calibration facilities, sponsored by the International Atomic Energy Agency. The second development that is discussed concerns the accuracy of the stripping ratios derived at Pelindaba and has important implications for in situ assaying.

32398 (UCID—20421-Vol.1) **Seismic hazard characterization of the eastern United States. Volume 1. Methodology and results for ten sites.** Bernreuter, D.L.; Savy, J.B.; Mensing, R.W.; Chen, J.C.; Davis, B.C. (Lawrence Livermore National Lab., CA (USA)). Apr 1985. Contract W-7405-ENG-48. 633p. NTIS, PC A99/MF A01 - GPO; GPO Dep. File Number TI85013208.

The objectives are: (1) to develop a seismic hazard characterization methodology for the region east of the Rocky Mountains; and (2) the application of the methodology to ten sites to assist the NRC staff in their assessment of the implications in the clarification of the US Geological Survey (USGS) position on the Charleston earthquake. The fundamental characteristic of the methodology used in SHC consists in using opinions for all the input data. The most important improvement over the methodology used in the SEP leads to an estimate of the distribution of the hazard rather than just point estimates. An important aspect of eliciting expert opinion consists in holding feedback meetings in order to fine tune the methodology and the input data. Estimates of the hazard peak ground acceleration and spectral velocity at ten representative sites are discussed including a sensitivity analysis and a comparison with the SEP results at four sites. The methodology and the data were analyzed by a panel of experts in a formal peer review process to identify the weak points in the analysis and recommend improvements. The results were also compared with results obtained by using other methodologies such as the "Historical" method and other zonation and seismicity data provided by USGS. 23 refs.

32399 (UCID—20421-Vol.2) **Seismic hazard characterization of the eastern United States. Volume 2. Questionnaires.** Bernreuter, D.L.; Savy, J.B.; Mensing, R.W.; Chen, J.C.; Davis, B.C. (Lawrence Livermore National Lab., CA (USA)). Apr 1985. Contract W-7405-ENG-48. 372p. NTIS, PC A16/MF A01 - GPO ; GPO Dep. File Number TI85013209.

This report contains the information given to the experts of the Seismicity panel and the Ground Motion Model Panel. This information includes copies of the six questionnaires sent to the panel members. The responses to questionnaires Q1, Q2, Q3, and Q4 are not specifically given in this volume since they were not final. The reader may find a detailed description of these responses in our interim report. In addition, questionnaire Q6, which is the feedback questionnaire to the Ground Motion Panel contains a complete summary of the responses to the previous questionnaire to the Ground Motion Panel.

5803 Mineralogy, Petrology, And Rock Mechanics

REFER ALSO TO CITATION(S) 29910, 29911, 29952, 29953, 29967, 29971, 29972, 29991, 30019

32400 (BMI/OCRD—21) **Evaluation of technology for large- and small-diameter boreholes to characterize crystalline rock.** (Earth Technology Corp., Long Beach, CA (USA)). May 1985. Contract AC02-83CH10139. 230p. NTIS, PC A11/MF A01; GPO Dep. File Number DE85012821.

Testing methods that have been used in large- and small-diameter boreholes (152 and 76 mm [6 and 3 in.]) were evaluated on their ability to characterize crystalline rocks. The methods evaluated included in-hole geomechanical, geophysical, and geohydrologic techniques and associated laboratory core tests; specific emphasis was on techniques that might be used in a field characterization program involving a small number of deep (up to 1500 m [5000 ft]) boreholes. Each technique was evaluated with regard to its effectiveness and limitations, applicability to the acquisition of data for anticipated rock conditions, and adequacy for assessing the required rock/hydrologic characteristics. Many pertinent case histories that helped to assess applicability were reviewed. A principal objective of the evaluations was to assess whether the techniques would be equally useful in both large- and small-diameter boreholes. Of the techniques evaluated, most are suitable for use in both large- and small-diameter boreholes. Borehole logging, hydrologic testing, and core-testing techniques provide suitable results in both borehole diameters. Geomechanical testing techniques provide suitable data in smaller diameter boreholes and have been designed for application at primarily shallow depths. The results of this study will be of use to the Office of Crystalline Repository Development (OCRD) in determining to what degree it is appropriate to use drilling, sampling, and testing techniques in small-diameter boreholes as opposed to large-diameter methods, while at the same time collecting adequate data for characterizing crystalline rock environments for potential use as a high-level radioactive waste repository. Additionally, further developmental work and specific testing techniques are recommended.

32401 (ENPU—81-10) **Porosity measurements of crystalline rocks by laboratory and geophysical methods.** Alexander, J.; Hall, D.H.; Storey, B.C. (Institute of Geological Sciences, Harwell (UK). Environmental Protection Unit). Dec 1981. 45p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85701042.

Porosity values of igneous and metamorphic crystalline rocks have been determined from core samples taken at specific depths from Altnabreac, by a combination of laboratory and geophysical techniques. Using resaturation and mercury injection methods in three laboratories within I.G.S., porosity values have been derived and the effect of variations in the measuring techniques and results obtained have been compared. Comparison of inter-laboratory porosity values illustrates that systematic errors are present, resulting in higher porosity values for samples subjected to re-testing. This is considered to be caused by the variable nature of the initial samples combined with the inability to completely dry or resaturate samples during a second testing. Geophysical techniques for determining in situ porosity using the neutron log have been carried out in borehole ALA. The neutron log has been calibrated with laboratory derived porosity values and an empirical formula derived enabling porosity values to be ascribed throughout the logged borehole ALA. Comparison of the porosity results from Altnabreac with crystalline samples elsewhere in America, Europe and the U.K. suggest that porosities at Altnabreac are lower than average. However, very few publications concerned with water movement in crystalline areas actually state the method used.

32402 (ENPU—82-10) **Analysis of in situ stress measurement by hydrofracturing, and the use of the borehole televiewer at Altnabreac.** McEwen, T.J. (Institute of Geological Sciences, Harwell (UK). Environmental Protection Unit). Oct 1982. 35p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85701043.

In situ stress measurement by hydrofracturing has been attempted in one deep borehole at Altnabreac in the Strath Halladale Granite. Although the results obtained were inconclusive, the hydrofracturing technique has been shown to be relatively simple to use in rocks of low permeability, and in addition the interpretation of the results is straightforward. The calculated in situ stresses exhibit a high horizontal stress ratio with the vertical stress being the intermediate stress. The borehole televiewer has been used to produce an acoustic picture of the borehole wall and is shown to be a valuable geophysical logging method for fracture analysis. The limitations of this technique are explained, and the results from the televiewer are compared with those derived from other methods of fracture analysis.

32403 (LA—10369-MS) Iron and manganese in oxide minerals and in glasses: preliminary consideration of Eh buffering potential at Yucca Mountain, Nevada. Caporuscio, F.A.; Vaniman, D.T. (Los Alamos National Lab., NM (USA)). Apr 1985. Contract W-7405-ENG-36. 31p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85011892.

The tuffs of Yucca Mountain at the Nevada Test Site are currently under investigation as a possible deep burial site for high-level radioactive waste disposal. One of the main concerns is the effect of oxidizing groundwater on the transport of radionuclides. Rock components that may affect the oxygen content of groundwater include Fe-Ti oxides, Mn oxides, and glasses that contain ferrous iron. Some phenocryst Fe-Ti oxides at Yucca Mountain are in reduced states, whereas groundmass Fe-Ti oxides have been oxidized to hematite, rutile, and pseudobrookite (Fe^{3+} -bearing phases) exclusively. Estimates of Fe^{2+} -bearing oxides indicate that less than 0.33 vol% phenocrysts is available to act as solid buffering agents of Eh. Of this percentage, significant amounts of Fe-Ti oxides are isolated from effective interaction with groundwater because they occur in densely welded, devitrified tuffs that have low interstitial permeability. Manganese oxides occur primarily along fractures in the ash-flow tuffs. Because the Mn oxides are concentrated along the same pathways (fractures) where transport has occurred in the past, these small volume percentages could act as buffers. However, the oxidation states of actual Mn-oxide phases are high (Mn^{4+}), and these minerals have virtually no potential for reducing groundwater Eh. Manganese oxides may even act as oxidizing agents. However, regardless of their poor capabilities as reducing agents, the Mn oxides could be important as sorbents of heavy metals at Yucca Mountain. The lack of accessible, pristine Fe-Ti oxides and the generally high oxidation states of Mn oxides seem to rule out these oxides as Eh buffers of the Yucca Mountain groundwater system. Reduction of ferrous iron within glassy tuffs may have some effect on Eh, but further study is needed. At present it is prudent to assume that minerals and glasses have little or no capacity for reducing oxygen-rich groundwater at Yucca Mountain. 25 refs., 3 figs., 12 tabs.

32404 (SAND—85-7166) WIPP horizon in situ permeability measurements. Final report. Peterson, E.; Lagus, P.; Brown, J.; Lie, K. (S-Cubed, La Jolla, CA (USA)). Jan 1985. Contract AC04-76DP00789. 102p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE85012687.

Eighteen gas permeability tests were conducted at the Waste Isolation Pilot Plant (WIPP) facility horizon in southeastern New Mexico. The objectives of the twelve Phase I tests were to determine: the permeability and porosity of the competent salt, the permeability variation with distance from the mined surface, and the influence of the interspersed clay and anhydrite seams on the measured permeability values. Six short duration "order-of-magnitude" permeability tests were performed as Phase II of this project. These tests were used to provide confirmation of the Phase I test results. Two types of test were performed. In one test the downhole pressure was maintained at an approximate constant value and the resulting flow measured. In the second, the test region was pressurized, then shut-in, and the pressure decay subsequently monitored. The resulting data were then used to infer permeability and porosity values. The test system and test technique used for the twelve Phase I tests were designed to evaluate formations having permeability to porosity ratios as low as 10^{-4} darcy. This downhole measurement system consisted of a dual packer assembly which isolated a test interval and adjacent guard interval. During a test, the test interval pressure, temperature, and flow (as well as the guard interval pressure) were measured. Use of the guard interval was critical to interpreting data obtained in these low permeability formations. Permeability and porosity values were inferred from the measured data using one-dimensional and two-dimensional axisymmetric solutions to equations describing gas flow through an isotropic porous medium. In those cases, where the analytical/numerical solutions failed to describe the measured response, additional testing should be performed to evaluate the formation characteristics.

32405 (SKBF-KBS-TR—79-11) Interpretation of permeability in an underground rock structure. Lindblom, U.; Norlen, A.; Granero, J.; Adolfsson, K. (Swedish Nuclear Fuel Supply Co., Stockholm. Div. KBS). Feb 1979. 32p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. File Number DE85701227.

The field study described in this paper was undertaken in a granitic rock mass. A large gas storage plant is excavated 130 m below the rock surface. Above the rock chambers, a system of closely spaced horizontal drillholes is overpressurized with water. Water pressures and water losses from this drillhole system, as well as gas pressure and water pumping from the rock chambers is closely controlled. Also the free groundwater surface is recorded in drillholes at the surface. The pressure situation in the rock mass above the caverns is measured. Pressure readings are taken in 2 m sections of two long drillholes, one vertical and one inclined 45 degree. Water losses in 2 m sections along the drill holes were controlled. A very sensitive monitoring system for water losses was developed, capable of recording hydraulic conductivities well below 10^{-11} m/s. Potential flow nets constructed under the assumption of a homogenous, isotropic rock permeability pointed at an average conductivity of 1,1 times 10^{-8} m/s for the rock as a whole. The precision determinations of water losses were interpreted as isotropic permeabilities of a porous medium. In the vertical drillhole, an average conductivity of 1,0 times 10^{-8} m/s was determined, whereas the inclined hole showed a conductivity of 4,2 times 10^{-8} m/s. However, if the results from the most fractured upper sections of this drillhole are omitted, then the average conductivity is 2,0 times 10^{-8} m/s. Thus, the investigation shows that in this rock mass it is possible to predict gross conductivity from packer tests in drillholes. The rock mass can then be interpreted as a porous medium. However, better than standard quality and precision is required for packers and reading equipment. The piezometric pressure readings confirmed that the overall flow situation was correctly assumed.

32406 (UCID—20351) Logging of post-test and CCH record core samples for the Spent Fuel Test-Climax. Thorpe, R.; Qualheim, B. (Lawrence Livermore National Lab., CA (USA)). Feb 1985. Contract W-7405-ENG-48. 113p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE85013036.

Over 1300 ft of core obtained from 50 boreholes are described, with emphasis on the nature and orientations of geologic discontinuities in the Climax Stock. Although most of the core was not oriented with respect to global coordinates, approximate orientations of planar features, such as joints, veins, and sheer fractures, were obtained by taking core measurements relative to a set of low-angle joints found throughout the rock mass. The method for determining the approximate core orientation is described in detail, and the associated uncertainty is discussed. A graphic fracture log for each hole is provided, along with the computer code used to generate it.

32407 (UCRL—53632) Field investigation of keyblock stability. Yow, J.L. Jr. (Lawrence Livermore National Lab., CA (USA)). Apr 1985. Contract W-7405-ENG-48. 247p. NTIS, PC A11/MF A01; 1; GPO Dep. File Number DE85012834.

Discontinuities in a rock mass can intersect an excavation surface to form discrete blocks (keyblocks) which can be unstable. This engineering problem is divided into two parts: block identification, and evaluation of block stability. One stable keyblock and thirteen fallen keyblocks were observed in field investigations at the Nevada Test Site. Nine blocks were measured in detail sufficient to allow back-analysis of their stability. Measurements included block geometry, and discontinuity roughness and compressive strength. Back-analysis correctly predicted stability or failure in all but two cases. These two exceptions involved situations that violated the stress assumptions of the stability calculations. Keyblock faces correlated well with known joint set orientations. The effect of tunnel orientation on keyblock frequency was apparent. Back-analysis of physical models successfully predicted block pullout force for two-dimensional models of unit thickness. Two-dimensional (2D) and three-dimensional (3D) analytic models for the stability of simple pyramidal keyblocks were examined. Calculated stability is greater for 3D analyses than for 2D analyses. Calculated keyblock stability increases with larger in situ stress magnitudes, larger lateral stress ratios, and larger shear strengths. Discontinuity stiffness controls block displacement more strongly than it does stability itself. Large keyblocks are less stable than small ones, and stability increases as blocks become more slender. Rock mass temperature decreases reduce the confining stress magnitudes and can lead to failure. The pattern of stresses affecting each block face explains conceptually the occurrence of pyramidal keyblocks that are truncated near their apex.

32408 (UCRL—92229) **Preliminary evaluation of alterant geophysical tomography in welded tuff.** Ramirez, A.L.; Daily, W.D. (Lawrence Livermore National Lab., CA (USA)). Feb 1985. Contract W-7405-ENG-48. 11p. (CONF-850671—18). NTIS, PC A02/MF A01; GPO Dep. File Number DE85012971.

From 26. U.S. symposium on rock mechanics; Rapid City, SD, USA (26 Jun 1985).

The ability of alterant geophysical tomography to delineate flow paths in a welded tuff rock mass has been preliminarily evaluated based on the results of a field experiment. Electromagnetic measurements were made before, during and after a water-based, dye tracer flowed through the rock mass. Alterant geophysical tomographs were generated and compared with independent evidence - borescope logs, neutron logs and dyed rock samples. Anomalies present in the tomograph match the location and orientation of fractures mapped with a borescope. The location of tracer-strained fractures coincides with the location of some image anomalies; other geophysical anomalies exist where tracer-strained fractures were not observed, perhaps due to poor core recovery. Additional drilling to locate stained flow paths and other experiments are planned so that the applicability of the technique can be further evaluated. 7 refs., 5 figs.

5804 Geochemistry

REFER ALSO TO CITATION(S) 29866, 29905, 29941, 29942, 29943, 29944, 29945, 29946, 29948, 29949

32409 (DOE/ER/13259—T1) **Thermally induced chemical migration: a natural analog approach. Progress report, September 1984-September 1985.** Papike, J.J. (South Dakota School of Mines and Technology, Rapid City (USA)). 26 Apr 1985. Contract FG01-84ER13259. 51p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85012308.

The objective has been to understand the extent and mechanisms of chemical migration in the broadest sense, i.e., over a range of temperatures and in diverse geologic media. Pegmatites are genetic links between "normal granites" and hydrothermal systems. At some stage in their crystallization history with falling temperature (and sometimes pressure) an aqueous fluid phase exsolves and coexists with a silicate melt. Little is known about the composition of these fluids, the element partitioning behavior between fluid and silicate melt, and how these fluids interact with previously crystallized granite. It is these fluids that "leak" out of the pegmatites and form the dispersion halos that we are studying. Research progress is reported in the following areas: (1) fluid evolution in the Notch Peak, Utah, metamorphic aureole; (2) tourmaline as a recorder of pegmatite evolution; (3) feldspar as a recorder of pegmatite evolution; (4) the distribution of boron among pegmatite minerals and the mass balance of boron in granitic pegmatite systems; (5) crystal chemical aspects of Li, Pb, and Cs partitioning between coexisting muscovite and biotite; (6) apatite as a recorder of pegmatite petrogenesis; (7) mineralogy and REE geochemistry of an S-type granite; (8) exomorphic aureoles as indicators of pegmatite fluid composition; (9) anatomy of a layered granite pluton; and (10) fractionation within a granitic system. (ACR)

5805 Oceanography

REFER ALSO TO CITATION(S) 32545

32410 (NP—5900966) **Geological study on the shallow water.** (Korean Inst. of Energy and Resources, Seoul (Republic of Korea)). 1983. 69p. (In Korean). NTIS (US Sales Only), PC A04/MF A01. File Number DE85900966.

For the compilation of a submarine geological map of Korean continental shelf, a marine geological investigation was made as one of annual projects of KIER during 1982. A total of 1125 line-Km of geophysical survey and 183 samples of sea-floor sediments were taken on the continental shelf from Cheju strait to Geomun Island, off the southern part of Korean Peninsula; 33°30'-34°30'N, 127°00'-127°30'E. According to the results from the interpretation of geophysical data and the analyses of samples, the recent sediments overlying Cretaceous volcanic basement can be divided into two depositional sequences by a local unconformity. Young sediment cover, with the maximum thickness of 30m, is composed of fine sediments which might be derived from Seomjin River. These young sediments are distributed only at the northern part of the project area and are named here Seomjin deposit. Depositional sequence under the local unconformity, is composed of coarser sediments than Holocene muddy sediments and widely distributed on the study area. Especially, at the zone of 110 +- 10 m in water depth, the superficial sediments have negative values in skewness and mean phi values of 1 to 3 phi. The similarities of characteristics of beach sand in textural parameter and its internal depositional structure suggest that the scarp with the height of 20m was a beach zone during the last glacial stage. 14 refs., 9 figs., 5 tabs.

32411 **"Pycnobathic" currents over the upper continental slope.** Csanady, G.T. (Woods Hole Oceanographic Institution, Woods Hole, MA 02543). *Journal of Physical Oceanography;* **15**: No. 3, 306-315(Mar 1985). Contract AC02-79EV10005.

The dynamic interaction of a sloping seafloor with along-isobath density variation is calculated for cases involving a sharp pycnocline and a surface-to-bottom front. Pycnocline depth is supposed to vary in the alongshore direction only, over a slopping plane seafloor, the bottom trace of the surface-to-bottom front is supposed to cut across isobaths. The calculations are diagnostic and make use of linearized equations with a linear bottom friction term.

32412 **Sea surface temperatures computed by a simple ocean mixed layer coupled to an atmospheric GCM.** Meehl, G.A.; Washington, W.M. (National Center for Atmospheric Research, Boulder, CO 80307). *Journal of Physical Oceanography;* **15**: No. 1, 92-104(Jan 1985).

An ocean mixed layer with fixed depth (50 m) is coupled to a global atmospheric general circulation model (GCM). The mixed layer is a simple slab that allows for seasonal heat storage but has no dynamics (advection or diffusion). The sea surface temperatures generated by the model are compared to observations for January and July. The overall simulation of ocean temperature is reproduced even with this simple ocean model. However, there are important discrepancies. Because of the lack of dynamics, the tropical upwelling regions are too warm in the model. Most Northern Hemisphere midlatitude ocean areas are too cool during summer due to the absence of shallowing of the mixed layer at that time of year.

32413 **Cyclonic eddies in the eastern Gulf of Mexico.** Vukovich, F.M.; Maul, G.A. (Research Triangle Institute, Research Triangle Park, NC 27709). *Journal of Physical Oceanography;* **15**: No. 1, 105-117(Jan 1985).

Cold-domed cyclonic eddies juxtaposed to the cyclonic shear side of the Gulf Loop Current are observed in simultaneously obtained hydrodgraphic, current meter mooring, and satellite infrared data. The cyclones are initially observed in the satellite data as cold perturbations on the northern extreme of the current and grow either into a cold tongue or a quasi-stable meander off the Dry Tortugas, Florida. Area shipboard surveys show closed isopleths of temperature and salinity, and surface geostropic current speeds relative to 1000 db are in excess of 100 cm s^{-1}. The diameter of the cold domes varied from 80 to 120 km. Separation of large anticyclonic rings is always observed to be preceded by cylonic eddies in the transition zone between Campeche Bank and the West Florida Shelf, but only on the eastern side. Not every cyclonic eddy off Dry Tortugas is associated with the separation of an anticyclonic ring; some are eroded away by the Florida Current, but they have never been observed in 10 years of satellite data to advect eastward through the Straits of Florida.

64 PHYSICS. I.

REFER ALSO TO CITATION(S) 32660

6401 Astrophysics And Cosmology

REFER ALSO TO CITATION(S) 32691, 32874

32414 **(AD-A—152027/9/XAB) Very Large Array observations of coronal loops and related observations of solar-type stars. Annual scientific report, 1 January-31 December 1984.** Lang, K.R. (Tufts Univ., Medford, MA (USA). Dept. of Physics). 29 Jan 1984. 118p. NTIS, PC A06/MF A01.

Observations of solar-active regions with the Very Large Array (V.L.A.) led to a new understanding of the origin and prediction of the solar bursts that disrupt communication systems and interfere with high-flying aircraft. The V.L.A. was used to delineate the temperature and magnetic structure at different heights in coronal loops, and the magnetic field strength was also determined. Much of the visible solar disk was resolved at 20-cm wavelength with 2.6-in. angular resolution. Snapshot maps at intervals of 3 seconds were used to specify changes in the temperature and the magnetic field before and during solar bursts. These snapshot maps were used to investigate the flow of plasma within coronal loops during solar bursts. Postflare loop systems were similarly investigated. These V.L.A. observations provided new information on coronal heating and emerging magnetic loops that may trigger the emission of solar bursts.

32415 **(CBPF-NF—002/83) Comparison of C-jet events with accelerator results.** Arata, N. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1983. 10p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85701438.

A comparison is made of cosmic-ray induced C-jet events with accelerator results, mainly from the CERN ISR and the CERN SPS pp sub(-) Collider. The distributions of energy, emssion angle and transverse momentum of γ-rays are discussed. Importance of the study on such events with high multiplicity, large p sub(T), jet structure and association of new particles is emphasized.

32416 **(CBPF-NF—010/83) Eternal universe.** Novello, M.; Heintzmann, H. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1983. 10p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85701436.

A new generalized solution of Maxwell-Einstein equations (which are non-minimally coupled) which leads to some fascinating aspects of the Universe is presented. The Cosmos has no singularity due to the coupling of longitudinal electromagnetism with space-time. It contains the Milne-Schucking cosmos as a limiting case. This model contains a free parameter (the longitudinal electromagnetic field) which allows one to fix the density of highest compression of the Cosmos. Alternatively the parameter allows one to adjust our cosmos to the presently observed Hubble constant and the deceleration parameter. The model seems to be a viable candidate for our real cosmos as it allows one to extend the time scale of the Universe to arbitrarily large values i.e., it is able to provide the necessary time scale for the origin of life. It is speculated that the entropy is finite but intelligence in the Universe may be infinite.

32417 **(CBPF-NF—012/83) Stability of the Einstein universe.** Soares, I.D. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1983. 13p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85701437.

It is shown sthat the Einstein Universe is stable by a large class of exact perturbations, which are made starting from a detailed exam of the topology of the model, and which include perturbations of the type considered by Lemaitre. The problem is reduced to the one-dimensional motion of a particle, in a potential well whose minimum corresponds to the configuration of the Einstein Universe.

32418 **(CBPF-NF—018/83) Evolution of pulsarmagnetism by virtue of a Faraday dynamo mechanism.** Heintzmann, H.; Novello, M. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1983. 13p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85701434.

The evidence that radio-pulsars are slowed-down and Roentgen - pulsars accelerated predominantly by magnetic torques is now very strong. Angular momentum is transferred away from the neutron star to the velocity-of-light cylinder or from the Alfven - cylinder down to the neutron star by means of a magnetic spring the physical origin of which is an appropriate current flowing along the magnetic field lines. As this current must be closed at the neutron star's surface and no Hall-Field can be built-up a Faraday dynamo mechanism is set up. It is pointed out that this mechanism could switch -off a radio pulsar or turn-on a Roentgen pulsar. Many disconcerting pulsar observations could thus be explained, if radio pulsars can be reactivated in the galactic plane by means of accretion of matter in dense clouds and if Roentgen pulsars must first create a sufficiently strong magnetic field to function as a regularly pulsed emitter.

32419 **(DOE/ER/10753—5) Solar variability observed through changes in solar figure and mean diameter.** Hill, H.A. (Arizona Univ., Tucson (USA). Dept. of Physics). 24 May 1985. Contract AC02-80ER10753. 18p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85012857.

A program to monitor solar luminosity variations through diameter measurements has been operation at SCLERA since 1981. The solar diameter is currently measured at multiple angles from the equator. Measurements at these different angles have the advantage that, not only can the solar oblateness be accurately measured, but, also, systematic errors, introduced by atmospheric refraction, can be reduced to a minimum. The primary emphasis during the last year has been on data analysis and interpretation. An extension of theoretical work relevant to the relationship between the solar diameter and luminosity for long-period oscillations has been extended to include 160 min period oscillations, and several tests have been completed. An absolute calibration system for the telescope field has been constructed and is being tested. A review of this work is presented.

32420 **(IFT-P—03/83) Compactification of Friedmann's hyperbolic model.** Fagundes, H.V. (Instituto de Fisica Teorica, Sao Paulo (Brazil)). Apr 1983. 6p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85701000.

A compact hyperbolic 3-manifold is substituted for the infinite space H^3, as space section of Friedmann's cosmological model of negative curvature. Some observational consequences are briefly analyzed.

32421 **(INIS-mf—9502) Groups and clusters of galaxies. Radio and X-ray studies.** Bijleveld, W. (Rijksuniversiteit Leiden (Netherlands)). 9 May 1984. 107p. NTIS (US Sales Only), PC A06/MF A01. File Number DE85780919.

Includes Dutch summary.

In this thesis, a correlative study is performed with respect to the radio and X-ray parameters of galaxy clusters and groups of galaxies (Msub(v)-Psub(1.4); Msub(v)-Lsub(x); Lsub(x)-Psub(1.4); R-Msub(v) correlations). Special attention is paid to correlations with cD and elliptical galaxies. It is concluded that in rich clusters massive cD galaxies form; massive galaxies are able to bind a large X-ray halo; strong X-ray emitters fuel their central radio sources at a high rate; the total gas content of groups is low, which implies that the contribution of groups to the total matter density in the universe is small.

32422 **(IPNO-TH—84-3) Equation of state of hot dense matter.** Vautherin, D. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). Mar 1983. 11p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85751320.

The approaches which have been used so far to calculate the equation of state of hot dense matter are briefly reviewed.

32423 (IPNO-TH—84-4) **Thomas-Fermi equation of state of hot dense matter.** Suraud, E. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). Nov 1983. 7p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85751321.

We report on the results of some Thomas-Fermi calculations of the equation of state (EOS) of Supernovae Matter. These calculations involve a complete solution of the Thomas-Fermi equations using a procedure derived from the imaginary time step method of reference [I].

32424 (JINR-D—2,-13-83-689, pp 47-59) **Possibility of generating gravitational waves of optical SHF- and UHF-ranges using intense coherent radiation and on the detection of waves for a number of gravity theories.** Pisarenko, V.G. (AN Ukrainskoj SSR, Kiev. Inst. Geofiziki). 1983. (In Russian). NTIS (US Sales Only), PC A08/MF A01. File Number DE85780874. (CONF-8306179—).

From Working meeting on problems of radiation and detection of gravitational waves; Dubna, USSR (7 Jun 1983).

The problem of generating gravitational waves of optical, SHF and UHF-ranges using coherent radiation and detecting waves for a number of gravitation theories is considered. Gravitational radiation generation in a crystal to account for polariton effects in the course of propagation of electromagnetic waves and the absorption zone of the latter is described. The calculation of the expected power absorbed by a concrete variant of the gravitational wave detector on eleastically bound masses in the proper detector reference system is given. Main effects of non-linear optics manifested at high densities of the electromagnetic radiation in the working environment, self-focusing and generation of combination and multiple harmonics are reported. By the method of holographic correction of intense radiation harmful self-focusing effects in the environment are eliminated. The expected differences of effects of the hertz gravitational experiment in various gravitation theories concerning GRT are given.

32425 (JINR-D—2,-13-83-689, pp 94-97) **Circular amplification method for light wave signal in a gravitational wave detector.** Basha, S.G.; Lyablin, M.V.; Plis, Yu.A. 1983. (In Russian). NTIS (US Sales Only), PC A08/MF A01. File Number DE85780874. (CONF-8306179—).

From Working meeting on problems of radiation and detection of gravitational waves; Dubna, USSR (7 Jun 1983).

Two cyclic amplification modes in a three-mirror resonator of a signal light wave generated as a result of gravitational radiation parametric transformation are considered in the paper: the mode of complete locking of the signal wave in the resonator and partial locking mode. The calculation shows that the first wave amplification method is considerably more effective than the second method under all values of the complete amplification increment for a cycle.

32426 (JINR-D—2,-13-83-689, pp 157-168) **Seismic detection in the pulsar frequency range.** Dolgikh, G.I.; Kopvillem, U.Kh.; Mezikov, S.M. (AN SSR, Vladivostok. Dal'navostochnyh Nauchnyj Tsentr). 1983. (In Russian). NTIS (US Sales Only), PC A08/MF A01. File Number DE85780874. (CONF-8306179—).

From Working meeting on problems of radiation and detection of gravitational waves; Dubna, USSR (7 Jun 1983).

Data on seismic investigations obtained by means of a 105-meter optical interferential deformometer in the Primore in 1977 are discussed. The data on changes in seismic signals with periods T1=0.127s, T2=0.585s and T3=0.325s for 24-hours are presented. The periods T1 and T2 are equal respectively to half-periods of CP 0950 and CP 1133 pulsars measured in a radiofrequency range. The minimum and maximum relative value of seismic signal amplitudes with the T1 and T2 period is shown. Arguments in favour of a possible explanation of physical nature of T1, T2 and T3 seismic signals by means of gravitational waves generated by pulsars are presented.

32427 (LA-UR—85-1742) **Cosmic-ray-produced gamma rays in planetary surfaces.** Reedy, R.C. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 5p. (CONF-850507—26). NTIS, PC A02/MF A01; GPO Dep. File Number DE85012750.

From International conference on nuclear data for basic and applied science; Santa Fe, NM, USA (13 May 1985).

A major priority of future NASA planetary missions is the determination of the elemental compositions of solar system objects. Gamma-ray spectroscopy will probably be used soon to determine the surface compositions of Mars and other solar system objects. Neutrons induced by the cosmic rays produce many of the important γ-ray lines that escape from planets. Some measurements of the γ rays produced by neutrons and protons with various energies have recently been made. However, many more nuclear measurements are still needed to plan for and to interpret the results from future planetary missions. Excitation functions for the production of γ-ray lines by both neutrons and protons are needed in calculating the fluxes of γ rays in and above a planet's surface. Thick-target irradiations with high-energy protons have simulated the production of γ rays by the cosmic rays, and more simulations are planned. 8 refs.

32428 (N—85-16729) **Galactic gamma-ray distribution: implications for galactic structure and the radial cosmic ray gradient.** Harding, A.K.; Stecker, F.W. (National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center). Nov 1984. 28p. (NASA-TM—86173). NTIS, PC A03/MF A01.

The radial distribution of gamma ray emissivity in the Galaxy was derived from flux longitude profiles, using both the final SAS-2 results and the recently corrected COS-B results and analyzing the northern and southern galactic regions separately. The recent CO surveys of the Southern Hemisphere, were used in conjunction with the Northern Hemisphere data, to derive the radial distribution of cosmic rays on both sides of the galactic plane. In addition to the 5 kpc ring, there is evidence from the radial asymmetry for spiral features which are consistent with those derived from the distribution of bright HII regions. Positive evidence was also found for a strong increase in the cosmic ray flux in the inner Galaxy, particularly in the 5 kpc region in both halves of the plane.

32429 (N—85-17763) **Nonthermal radio emission and the HR diagram.** Gibson, D.M. (Joint Inst. for Lab. Astrophysics, Boulder, CO (USA)). Jan 1985. 5p. NTIS, PC A12/MF A01.

In NASA, Goddard Space Flight Center, the origin of non-radiative heating/momentum in hot stars, 70-74 p. (N—85-17755 08-88).

Perhaps the most reliable indicator of non-radiative heating/momentum in a stellar atmosphere is the presence of nonthermal radio emission. To date, 77 normal stellar objects have been detected and identified as nonthermal sources. These stellar objects are tabulated herein. It is apparent that non-thermal radio emission is not ubiquitous across the HR diagram. This is clearly the case for the single stars; it is not as clear for the binaries unless the radio emission is associated with their late-type components. Choosing to make this association, the single stars and the late-type components are plotted together. The following picture emerges: (1) there are four locations on the HR diagram where non-thermal radio stars are found; (2) the peak incoherent 5 GHz luminosities show a suprisingly small range for stars within each class; (3) the fraction of stellar energy that escapes as radio emission can be estimated by comparing the integrated maximum radio luminosity to the bolometric luminosity; (4) there are no apparent differences in L sub R between binaries with two cool components, binaries with one hot and one cool component, and single stars for classes C and D; and (5) The late-type stars (classes B, C, and D) are located in parts of the HR diagram where there is reason to suspect that the surfaces of the stars are being braked with respect to their interiors.

32430 (N—85-17764) **X-ray activity in pre-main sequence stars.** Feigelson, E.D. (Pennsylvania State Univ., University Park (USA)). Jan 1985. 6p. NTIS, PC A12/MF A01.

In NASA, Goddard Space Flight Center, the origin of nonradiative heating/momentum in hot stars, 75-80 p. (N—85-17755 08-88).

X-ray findings and their interpretation with respect to winds and surface activity of pre-main sequence stars are summarized. Some recent optical and radio observations supporting the X-ray evidence for giant flares on PMS stars are discussed. The unusual properties of PMS/T Tauri stars were for many years primarily attributed to their strong winds. Numerous lines of evidence are outlined herein indicating that PMS stars also have enhanced surface activity, including extremely strong individual flares.

32431 (N—85-17779) Bipolar flows and X-ray emission from young stellar object. Uchida, Y.; Shibata, K. (Tokyo Astronomical Observatory (Japan)). Jan 1985. 8p. NTIS, PC A12/MF A01.

In NASA, Goddard Space Flight Center, the origin of nonradiative heating/momentum in hot stars, 169-176 p. (N—85-17755 08-88).

Production of both the large scale CO bipolar flows and the small scale optical bipolar jets from the star-forming regions is given interpretation in terms of a magnetic mechanism related to accretion model. It is shown by an axisymmetric 2.5-dimensional simulation that the large scale cold bipolar flow may be produced in the relaxation of the magnetic twist which is created by the rotational winding-up of the magnetic field in the contracting disk. In contrast, the small scale warm bipolar jets may be driven by the recoiling shocks which are produced in the crash at the stellar surface of the infalling material released from the inner edge of the disk through magnetic reconnections.

32432 (N—85-17820) HEAO-1 diffuse component spectrum from 15 to above 500 keV. Gruber, D.E.; Rothschild, R.E.; Matteson, J.L.; Kinzer, R.L. (California Univ., San Diego (USA)). Oct 1984. 3p. NTIS, PC A13/MF A01.

In Max-Planck Inst. fuer Physik und Astrophysik, x-ray and uv emission from active galactic nuclei, 129-134 p. (N—85-17790 08-88).

The spectrum of the diffuse X and gamma-ray background was measured over a band of 2 decades with scintillator detectors aboard the HEAO-1 satellite. The apertures of the detectors were modulated on time scales of hours and the difference in counting rates measured the diffuse component flux. The observed spectrum is presented and compared with other measurements. The possible contribution to the diffuse component above 100 keV from active galaxies is discussed. (ESA)

32433 (N—85-17926) SU(2) x U(1) vacuum and the Centauro events. Kazanas, D.; Balasubrahmanyan, V.K. (National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center). Apr 1984. 15p. (NASA-TM—86082). NTIS, PC A02/MF A01.

It is proposed that the fireballs invoked to explain the Centauro events are bubbles of a metastable superdense state of nuclear matter, created in high energy (E is approximately 10 to the 15th power eV) cosmic ray collisions at the top of the atmosphere. If these bubbles are created with a Lorentz factor gamma approximately = 10 at their CM frame, the objections against the origin of these events in cosmic ray interactions are overcome. Assuming further, that the Centauro events are to the explosive decay of these metastable bubbles, a relationship between their lifetime, tau, and the threshold energy for bubble formation, E sub th, is derived. The minimum lifetime consistent with such an interpretation in tau is approximately 10 to the -8th power sec, while the E sub th appears to be insensitive to the value of tau and always close to E sub th is approximately 10 to the 15th power eV. Finally it is speculated that if the available CM energy is thermalized in such collisions, these bubbles might be manifestations of excitations of the SU(2) x U(1) false vacuum. The absence of neutral pions in the Centauro events is then explained by the decay of these excitations.

32434 (N—85-18909) X-ray spectra of supernova remnants. Szymkowiak, A.E. (National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center). Feb 1985. 117p. (NASA-TM—86169; M—37). NTIS, PC A06/MF A01.

X-ray spectra were obtained from fields in three supernova remnants with the solid state spectrometer of the HEAO 2 satellite. These spectra, which contain lines from K-shell transitions of several abundant elements with atomic numbers between 10 and 22, were compared with various models, including some of spectra that would be produced by adiabatic phase remnants when the time-dependence of the ionization is considered.

32435 (N—85-18911) Instrumental background in balloon-borne gamma-ray spectrometers and techniques for its reduction. Gehrels, N. (National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center). Jan 1985. 88p. (NASA-TM—86162). NTIS, PC A05/MF A01.

Instrumental background in balloon-borne gamma-ray spectrometers is presented. The calculations are based on newly available interaction cross sections and new analytic techniques, and are the most detailed and accurate published to date. Results compare well with measurements made in the 20 keV to 10 MeV energy range by the Goddard Low Energy Gamma-ray Spectrometer (LEGS). The principal components of the continuum background in spectrometers with GE detectors and thick active shields are: (1) elastic neutron scattering of atmospheric neutrons on the Ge nuclei; (2) aperture flux of atmospheric and cosmic gamma rays; (3) beta decays of unstable nuclides produced by nuclear interactions of atmospheric protons and neutrons with Ge nuclei; and (4) shield leakage of atmospheric gamma rays. The improved understanding of these components leads to several recommended techniques for reducing the background.

32436 (N—85-18913) Progenitors of white dwarfs. Drilling, J.S.; Schoenberner, D. (Louisiana State Univ., Baton Rouge (USA)). 1985. 11p. (NASA-CR—174378). NTIS, PC A02/MF A01.

Direct observational evidence is presented which indicates that the immediate progenitors of white dwarfs are the central stars of planetary nebulae (approximately 70%), other post-AGB objects (approximately 30%), and post-HB objects not massive enough to climb the AGB (approximately 0.3%). The combined birth rate for these objects is in satisfactory agreement with the death rate of main-sequence stars and the birth rate of white dwarfs.

32437 (N—85-18935) Data analysis of electron measurements of the plasma experiment aboard the HELIOS probes. Pilipp, W.G.; Miggenrieder, H.; Muehlhaeuser, K.H. (Max-Planck-Institut fuer Physik und Astrophysik, Garching (Germany, F.R.)). Nov 1984. 48p. (MPE—185). NTIS, PC A03/MF A01.

Methods to derive distribution functions for solar wind electrons from the measurements of the plasma experiment aboard the HELIOS probes are outlined. Electrons are measured in the energy range from 0.5 to 1660 eV with one-dimensional angular resolution along the ecliptic plane. From these measurements electron distribution functions with high time resolution (18 sec) but poor angular resolution in velocity space (45 deg) and electron distribution functions with high angular resolution (5 to 10 deg) but poor time resolution (several minutes to few hours) are derived. (ESA)

32438 (N—85-18941) UCB cosmic ray experiment. Final report. (Bell Bros. Research Corp., Gardena, CA (USA)). 1984. 50p. NTIS, PC A03/MF A01.

The instrument package for measuring the abundance of heavy ions, primary cosmic rays ranging from hydrogen to iron, uses a lithium drifted silicon detector array to measure the ionization of minimizing ions. The direction of travel is defined by a drift chamber array. A simplified block diagram is presented as well as engineering drawings and specifications.

32439 (N—85-18942) Gamma-ray burster recurrence timescales. Schaefer, B.E.; Cline, T.L. (National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center). Sep 1984. 19p. (NASA-TM—86157). NTIS, PC A02/MF A01.

Three optical transients have been found which are associated with gamma-ray bursters (GRBs). The deduced recurrence timescale for these optical transients (tau sub opt) will depend on the minimum brightness for which a flash would be detected. A detailed analysis using all available data of tau sub opt as a function of E(gamma)/E(opt) is given. For flashes similar to those found in the Harvard archives, the best estimate of tau sub opt is 0.74 years, with a 99% confidence interval from 0.23 years to 4.7 years. It is currently unclear whether the optical transients from GRBs also give rise to gamma-ray events. One way to test this association is to measure the recurrence timescale of gamma-ray events tau sub gamma. A total of 210 gamma-ray error boxes were examined and it was found that the number of observed overlaps is not significantly different from the number expected from chance coincidence. This observation can be used to place limits on tau sub gamma for an assumed luminosity function. It was found that tau sub gamma is approx. 10 yr if bursts are monoenergetic. However, if GRBs have a power law luminosity function with a wide dynamic range, then the limit is tau sub gamma 0.5 yr. Hence, the gamma-ray data do not require tau sub gamma and tau sub opt to be different.

32440 (N—85-19900) **Far-infrared line observations of planetary nebulae. 1: the 0 III spectrum.** Dinerstein, H.L.; Lester, D.F.; Werner, M.W. (National Aeronautics and Space Administration, Moffett Field, CA (USA). Ames Research Center). Feb 1985. 46p. (NASA-TM—86670; REPT—85091). NTIS, PC A03/MF A01.

Observations of the far-infrared fine structure lines of O III have been obtained for six planetary nebulae. The infrared measurements are combined with optical O III line fluxes to probe physical conditions in the gas. From the observed line intensity ratios, a simultaneous solution was obtained for electron temperature and density, as well as means of evaluating the importance of inhomogeneities. Densities determined from the far-infrared O III lines agree well density diagnostics from other ions, indicating a fairly homogeneous density in the emitting gas. Temperatures are determined separately from the O III 4363/5007 A and 5007 A/52 micron intensity ratios and compared. Systematically higher values are derived from the former ratio, which is expected from a nebula which is not isothermal. Allowance for the presence of temperature variations within these nebulae raises their derived oxygen abundances, determinations to be reconciled with the solar value.

32441 (N—85-19901) **Boundary conditions for the paleoenvironment: chemical and physical processes in the presolar nebula.** Irvine, W.M.; Schloerb, F.P. (Massachusetts Univ., Amherst (USA)). Feb 1985. 10p. (NASA-CR—174370). NTIS, PC A02/MF A01.

Two additional hyperfine components of the interstellar radical C3H were detected. In addition, methanol was discovered in interstellar clouds. The abundance of HCCN and various chemical isomers in molecular clouds was investigated.

32442 (N—85-19904) **International Ultraviolet Explorer observations of amorphous hot galaxies.** Lamb, S.A.; Gallagher, J.S. III; Hjellming, M.S.; Hunter, D.A. (Illinois Univ., Urbana (USA)). Aug 1984. 46p. (NASA-CR—174354). NTIS, PC A03/MF A01.

In order to better understand the nature of star formation processes in amorphous galaxies, short wavelength International Ultraviolet Explorer (IUE) spectra of galaxies NGC 1705 and NGC 1800 were obtained. The IUE data for NGC 1705 were of excellent quality while the low signal-to-noise NGC 1800 observation was useful only as a rough guide to the ultraviolet energy distribution. It was found that NGC 1705 contains a normal mix of OB stars, which is consistent with the nearly constant recent star formation rate inferred from new optical data. The NGC 1800 is likely to have similar properties, and blue galaxies with amorphous structures thus do not show evidence for anomalies in stellar mass distributions. The UV spectra of amorphous galaxies and a variety of other hot extragalactic stellar systems have similar characteristics, which suggests OB stellar populations often are homogeneous in their properties.

32443 (N—85-19905) **Spectroscopic study of LMC X-4.** Petro, L.D.; Hiltner, W.A. (Massachusetts Inst. of Tech., Cambridge (USA)). 1982. 16p. (NASA-CR—174414). NTIS, PC A02/MF A01.

The orbital radial velocity semi-amplitude of the binary star system LMC X-4 primary was determined to be 37.9 + or - 2.4 km/s from measurements of the hydrogen absorption lines. The semi-amplitude of the He I and He II absorption lines are consistent with this, namely 44.9 + or - 5.0 and 37.3 + or - 5.3 km/s. The phase and shape of the radial velocity curves of the three ions are consistent with a circular orbit and an ephemeris based upon X-ray measurements of the neutron star, with the exception that the He II absorption line radial velocity curve has detectable shape distortion. Measurements of the He II LAMBOA 4686 emission line velocity are consistent with a phase shifted sine wave of semi-amplitude 535 km/s, a square wave of semi-amplitude 407 km/s, or high order harmonic fits. The spectral type was found to be 08.5 IV-V during X-ray eclipse. Variations to types as early as 07 occur, but not as a function or orbital phase. Absorption line peculiarities were noted on 6 of 58 spectra.

32444 (N—85-19912) **Solar Corona Explorer: a mission for the physical diagnosis of the solar corona.** (National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center). Jul 1981. 82p. (NASA-TM—87416). NTIS, PC A05/MF A01.

Mission objectives and spacecraft requirements for the Solar Corona Explorer (SCE), a proposed free flying, unmanned solar research craft to be tenatively launched in 1987, were defined. The SCE's purpose is to investigate structure, dynamics and evolution of the corona, globally and in the required physical detail, to study the close coupling between the inner corona and the heliosphere. Investigative objectives are: (1) to understand the corona as the source of varying interplanetary plasma and of varying solar X-ray and extreme ultraviolet fluxes; (2) to develop the capabilities to model the corona with sufficient precision to forecast the Earth's variable environment in space, on the scales from weeks to years; (3) to develop an understanding of the physical processes that determine the dynamics and physical state of the coronal plasma, particularly acceleration processes; and (4) to develop insight and test theory on the Sun applicable to stellar coronae and winds, and in particular, to understand why cool stars put such a large fraction of their energy into X-rays. Considered related factors are: (1) duration of the mission; (2) onboard measuring instrumentation; (3) ground support equipment and procedures; and (4) programs of interpretation and modeling.

32445 (N—85-19913) **Directivity of Bremsstrahlung radiation from relativistic beams and the gamma-rays from solar flares.** Petrosian, V. (Stanford Univ., CA (USA)). Feb 1985. 30p. (NASA-CR—174433). NTIS, PC A03/MF A01.

It has been observed that flares with greater than 10 MeV gamma-ray emission are concentrated around the solar limb with a dispersion of 10 to 20 degrees. It is shown that the bremsstrahlung by relativistic electrons is responsible for such gamma-rays and that the expected relativistic beaming cannot explain this dispersion. It is argued that this dispersion is predominately a reflection of the pitch angle distribution of the electrons. Then it is shown that this requires a small variation of the magnetic field from the point where the electrons are injected to the photosphere and a nearly isotropic (in the downward direction) pitch angle distribution at the injection. The influence of other effects on the observed distribution is also discussed.

32446 (N—85-19916) **X-ray bursts: observation versus theory.** Lewin, W.H.G. (Massachusetts Inst. of Tech., Cambridge (USA)). 1981. 10p. (NASA-CR—174415). NTIS, PC A02/MF A01.

Results of various observations of common type I X-ray bursts are discussed with respect to the theory of thermonuclear flashes in the surface layers of accreting neutron stars. Topics covered include burst profiles; irregular burst intervals; rise and decay times and the role of hydrogen; the accuracy of source distances; accuracy in radii determination; radius increase early in the burst; the super Eddington limit; temperatures at burst maximum; and the role of the magnetic field.

32447 **(PUC-TN—08/83) Quantum and thermodynamic aspects of Black Holes.** Sande e Lemos, J.P. de; Videira, A.L.L. (Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Fisica). 1983. 33p. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. File Number DE85701435.

The main results originating from the attempts of trying to incorporate quantum and thermodynamic properties and concepts to the gravitational system black hole, essentially the Hawking effect and the four laws of thermodynamics are reviewed.

32448 **(UCRL—92672) Some nuclear data needs in astrophysics.** Mathews, G.J.; Bauer, R.W.; Bloom, S.D.; Haight, R.C.; Howard, W.M.; Takahashi, K.; Ward, R.A. (Lawrence Livermore National Lab., CA (USA)). May 1985. Contract W-7405-ENG-48. 20p. (CONF-850507—20). NTIS, PC A02/MF A01; GPO Dep. File Number DE85012916.

From International conference on nuclear data for basic and applied science; Santa Fe, NM, USA (13 May 1985).

In this paper we discuss a number of astrophysical environments and how improved nuclear data could facilitate a better understanding of them. One area of interest includes proton and alpha-particle reactions with unstable nuclei which are necessary for understanding the nucleosynthesis and energy generation in hot hydrogen-burning environments. Efforts underway at LLNL and elsewhere to develop the technology for the measurement of these reaction rates are discussed. Heavy-element nucleosynthesis in the late stages of red-giant stars and supernovae requires a complete network of neutron capture rates and beta-decay rates for nuclei near and far from stability. Experimental and theoretical efforts at LLNL to supply the input data and to model the nucleosynthetic environments will be outlined. Suggestions are made as to which nuclear data are most critical for the various scenarios. 42 refs., 11 figs., 1 tab.

32449 **(UCRL—92724) Stellar s-process diagnostics.** Mathews, G.J.; Ward, R.A.; Takahashi, K.; Howard, W.M. (Lawrence Livermore National Lab., CA (USA)). May 1985. Contract W-7405-ENG-48. 10p. (CONF-850375—5). NTIS, PC A02/MF A01; GPO Dep. File Number DE85012926.

From 20. Rencontre de Moriond; Les Arcs, France (10 Mar 1985).

We argue that the solar-system σN curve can be best understood if the s-process is largely produced by stars in the mass range of $M \sim 2$ to 4 $M_{\odot}$. Several observations are then studied as indicators of the validity of this hypothesis. We find that isotopic Zr abundances and elemental (Ba/Sr) vs (Ba/Nd) ratios are consistent with these conditions. The elemental (Tc/Nb) ratio is found not to be an indicator of temperature as has been suggested but rather a measure of the age of an AGB star in the third dredge-up phase.

32450 **Can the universe be charged?.** Orito, S.; Yoshimura, M. (Department of Physics, University of Tokyo, Bunkyo-ku Tokyo 113, Japan). *Physical Review Letters;* **54**: No. 22, 2457-2460(3 Jun 1985).

We point out a possibility of temporal charge nonconservation in cosmological models based on more-dimensional theories a la Kaluza-Klein. A net excess charge may then have been created before the extra dimensional space was compactified. Cosmological implications of the excess charge are discussed.

32451 **Calculation of neutrino flux from Cygnus X-3.** Gaisser, T.K.; Stanev, T. (Bartol Research Foundation of the Franklin Institute, University of Delaware, Newark, Delaware 19716). *Physical Review Letters;* **54**: No. 20, 2265-2268(20 May 1985). Contract AC02-78ER05007.

We estimate the flux of neutrinos produced by protons accelerated by the compact partner in Cygnus X-3. Such neutrinos are produced in collisions with the atmosphere of the companion, and there can be substantial modulation due to absorption in the companion. The resulting flux of upward muons induced by neutrinos in rock below an underground detector is at the level of 1 per 1000 m^2 per year.

32452 **Evidence for muon production by particles from Cygnus X-3.** Marshak, M.L.; Bartelt, J.; Courant, H.; Heller, K.; Joyce, T.; Peterson, E.A.; Ruddick, K.; Shupe, M.; Ayres, D.S.; Dawson, J.; Fields, T.; May, E.N.; Price, L.E.; Sivaprasad, K. (School of Physics, University of Minnesota, Minneapolis, Minnesota 55455). *Physical Review Letters;* **54**: No. 19, 2079-2082(13 May 1985).

We have observed underground cosmic-ray muons, corresponding to a secondary flux of $\sim 7 \times 10^{-11}$ cm^{-2} s^{-1}, at a depth of 1800-m water equivalent, which appear to be initiated by Cygnus X-3. This identification is based on both direction and phase coherence. The existence of such secondary muons conflicts with the current understanding of photon cascades and/or the nature and location of Cygnus X-3.

32453 **QUIP: A time-dependent standard model.** Munier, A. (Los Alamos National Laboratory). *Astrophysical Journal;* **290**: No. 1, 47-65(1 Mar 1985).

A time-dependent solution representing the monotonic expansion o contraction of a self-gravitating gas sphere with polytropic index QUIP (quasi-invariant polytrope) is obtained from group theory. Radiation is introduced into the model through a dynamic diffusion description. Compatibility between the equations of hydrodynamics and radiation leads to the definition of a (time-dependent) standard QUIP generalizing Eddington's standard (static) model. The second-order dimensionless ordinary differential equation depending on a characteristic time scale a, used to describe the model, is solved numerically. Integral theorems by Ritter, Milne, Eddington, and Chandrasekhar, valid for a static configuration, are generalized to the case of the standard QUIP provided that two quantities are introduced: a Q-factor and a normalized moment of inertia. These two functions are calculated for different values of a. The solution of the standard QUIP is proved to depend on only three initial conditions related to experimental values. All quantities such as the ratio of the mean to the central density, the central density, pressure and temperature, etc., are calculated. A mass—radius—hydrodynamical time scale relation is given, together with a luminosity formula. Families of standard QUIPS can be characterized by a constant Q-factor and an effective temperature.

32454 **Noble gas component organization in Apollo 14 breccia 14318: ^{129}I and ^{244}Pu regolith chronology.** Swindle, T.D.; Caffee, M.W.; Hohenberg, C.M.; Hudson, G.B.; Laul, J.C.; Simon, S.B.; Papike, J.J. (McDonnell Center for the Space Sciences and Department of Physics, Washington University). *Journal of Geophysical Research;* **90**: No. S2, C517-C540(15 Feb 1985).

Noble gas, petrological, and chemical studies made on grain-size separates from lunar regolith breccia 14318 demonstrate that the noble gases are organized into two functional components, volume-correlated and surface-correlated. As in regolith breccia 14301, volume-correlated xenon in 14318 is primarily spallation-derived and the surface-correlated component contains not only solar wind xenon but also significant amounts of "parentless' xenon from the fission of now extinct ^{244}Pu and the decay of now extinct ^{129}I ("parentless" means the daughter products were incorporated onto grain surfaces following decay of the parent nuclide elsewhere). The ratio of $^{129}Xe/^{136}Xe$ in the total surface-correlated parentless component, as identified in grain-size analysis, is substantially higher than in the least tightly bound parentless component identified in stepwise heating analyses, confirming the trend seen in 14301. If the order of release of gases in stepwise heating is related to the order of incorporation in the simplest way (first in, last out), incorporation of these grain-surface components was probably time-ordered. The $^{129}Xe/^{136}Xe$ ratio in each identifiable parentless component would then be characteristic of the xenon available for surface adsorption at the particular time of acquisition. Continuous variations in this ratio further suggest that incorporation of the parentless xenon was closely coupled with production. Such observations provide the basis for a new chronometer from which we conclude that acquisition of parentless xenon was an ongoing process spanning at least 90 m.y., beginning no more than 44 +- 34 m.y. after the formation of the most meteorites and possibly predating xenon acquisition for the earth.

32455 **Electromagnetic ion beam instabilities: Hot beams at interplanetary shocks.** Gary, S.P. (Earth and Space Sciences Division, University of California, Los Alamos National Laboratory). *Astrophysical Journal;* **288**: No. 1, 342-352(1 Jan 1985).

This paper considers Vlasov instabilities driven by a very hot ion beam streaming parallel to a magnetic field. The linear theory of electromagnetic instabilities driven by such a beam in a homogeneous, collisionless, nonrelativistic plasma is used. Numerical solutions of the full linear dispersion equation for bi-Maxwellian distribution functions are presented. If the thermal speed of the beam is greater than its drift speed, the two dominant modes are the right-hand and left-had resonant ion beam instabilities. The parametric dependencies of the threshold drift speeds and growth rates for both modes are presented. In particular, the thresholds are shown to be sensitive functions of the beam temperature anisotropies. Arguments are presented that these two modes is sufficient to account for the amplitudes of MHD-like waves observed at such shocks.

32456 **Finite temperature corrections in N = 1 supergravity.** Olive, K.A. (Fermi National Accelerator Lab., Batavia, IL (USA). Astrophysics Theory Group); Srednicki, M.A. (California Univ., Santa Barbara (USA). Dept. of Physics). *Physics Letters, [Section] B;* **148**: No. 6, 437-439(6 Dec 1984).

We compute finite temperature corrections to the scalar potential for an arbitrary N=1 supergravity model. Applications to the inflation potential used for primordial inflation are discussed.

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32457 **(AD-A—151414/0/XAB) Effects of finite-current-channel width on the current convective instability. Memorandum report, October 1983-October 1984.** Satyanarayana, P.; Chen, J. (Naval Research Lab., Washington, DC (USA)). 5 Mar 1985. 39p. (NRL-MR—5494). NTIS, PC A03/MF A01.

The effects of the finite-current channel width on the current-convective instability are studied both analytically and numerically. First, using a sharp-boundary field-aligned current distribution which has a finite width along the plasma-density gradient, the dispersion relation is obtained analytically. Numerically, results are also presented for a diffuse-boundary current velocity distribution. Applications to the high-latitude ionosphere are discussed.

32458 **(AD-A—151980/0/XAB) Effects of magnetic shear on lower hybrid waves in the suprauroral region. Final report, 1 April 1983-31 March 1984.** Bakshi, P. (Boston Coll., Chestnut Hill, MA (USA). Dept. of Physics). Jan 1985. 19p. NTIS, PC A02/MF A01.

Effects of magnetic shear on lower hybrid modes are investigated. It is shown that due to non-local effects, even a small shear can significantly affect the instability, leading to stabilization for some parameter ranges. These results are of importance in the context of the recently proposed mechanism of lower hybrid acceleration and ion evolution in the suprauroral region.

32459 **(N—85-17451) Plasma and magnetospheric research.** Comfort, R.H.; Horwitz, J.L. (Alabama Univ., Huntsville (USA)). Jan 1985. 13p. (NASA-CR—171293). NTIS, PC A02/MF A01.

Analysis techniques and software development, data analysis and modeling, spacecraft sheath effects, laboratory plasma flow studies, and instrument development are described.

32460 **(N—85-17461) Partial reflection D-region electron densities.** Manson, A.H.; Meek, C.E. (Saskatchewan Univ., Saskatoon (Canada)). Nov 1984. 11p. NTIS, PC A12/MF A01.

In International Council of Scientific Unions, middle atmosphere handbook, Vol. 13, 113-123 p. (N—85-17452 08-46).

The differential absorption technique of measuring electron densities as a function of height in the D region is discussed. In the basic experiment, pulses of medium or high frequency, usually at a fixed frequency (2 to MHz), are radiated upwards with known wave polarizatin (usually linear or circular) from a transmitter at ground level. Partial reflections, from ionospheric scatterers at heights below the E region, are received at the ground, and are resolved into two characteristic components, the ordinary (0) and extraordinary (E) modes whose amplitude ration A(x)/A(o) is then measured as a function of height, h. The heights of these are determined by delay times, the group retardation being minimal in the undisturbed D-region. The electronic system can be very simple. Power splitters and quadrature networks to separate the A(x) and A(o) components are commercially available at low prices and an A-D converter, height-gate system, and microcomputer allows the real-time calculation of mean amplitudes. The ratio of the coefficients of reflection of the two modes, as they originate at each reflection height is then calculable.

32461 **(N—85-17463) Incoherent scatter radar studies of the mesosphere.** Mathews, J.D. (Case Western Reserve Univ., Cleveland, OH (USA)). Nov 1984. 20p. NTIS, PC A12/MF A01.

In International Council of Scientific Unions, middle atmosphere handbook, Vol. 13, 135-154 p. (N—85-17452 08-46).

All current incoherent backscatter radars can make mesospheric or D region measurements under at least some conditions. The conditions under which measurements are possible are derived and shown for each radar. Conditions examined include overall system sensitivity, electron and ion spectral line widths and power distributions, and time/height averaging effects. The radar equations is derived and calibrations of the radar system is discussed. Total power only and combined total power and ion line spectral measurements are described in terms of ease of use, applicability to various radars, and parameters of aerodynamic interest derivable from the measurements.

32462 **(N—85-17468) D1 LF wind measurements in the 90 to 100 km height range.** Schminder, R.; Kurschner, D. (Leipzig Univ. (German Democratic Republic)). Nov 1984. 14p. NTIS, PC A12/MF A01.

In International Council of Scientific Unions, middle atmosphere program, Vol. 13, 241-261 p. (N—85-17452 08-46).

A short historical review of the development and use of D1 low frequency (LF) techniques for wind measurement is presented and the measuring and evaluation procedures are described. The advantages and disadvantages of D1 LF measurements are examined. Finally, the results of measurements over Central Europe acquired by the Collm Geophysical Observatory are discussed.

32463 **(N—85-17925) Current carriers for the field-aligned current system.** Hoffman, R.A.; Sugiura, M.; Maynard, N.C. (National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center). Sep 1984. 21p. (NASA-TM—86161; CONF-8406167—7). NTIS, PC A02/MF A01.

From 25. plenary session of COSPAR; Graz, Austria (25 Jun 1984).

The Dynamics Explorer satellites have returned a large body of data containing high resolution magnetometer measurements and distributions of charged particles of all but thermal electrons. From these data the relations of the field aligned currents to particle precipitation structures were investigated and the charge carriers were identified. Results include the following: (1) during very quiet periods, field aligned currents exist primarily as fine structure; (2) during onset of substorms, region 1 and region 2 become clearly evident but contain significant structure; (3) as magnetic activity subsides, current regions become less distinct, and structure becomes more dominant; (4) the distribution of the upward currents derived from magnetometer data and calculated from suprathermal electron data agree remarkably well in shape but not necessarily in magnitude; (5) at all local times; 5 eV electrons seldom carry most of the upward current; (6) except for the accelerated inverted-V electrons, the dominant upward current carriers which are measured are below 500 eV and are distributed in energy (7) dusk upward currents (region 1) are associated with the boundary plasma sheet and (8) suprathermal electron bursts are important current carrying structures.

32464 **(N—85-19823) Research study of space plasma boundary processes. Final report, 1 October 1983-30 September 1984.** Greenstadt, E.W.; Taylor, W.W.L. (TRW Space Technology Labs., Redondo Beach, CA (USA)). Oct 1984. 45p. (NASA-CR—174351). NTIS, PC A03/MF A01.

Representation of the Earth's bow shock and magnetopause and their geometrically determined macrostructure was investigated. Computer graphic depictions of the global distributions of bow shock structures and elementary animation of the dynamics of those distributions in the changing solar wind were developed. The shock-foreshock boundary and subcritical bow shocks as observed by ISEE 1 and 2 are discussed.

32465 **(SD-TR—84-50) Earth's radiation belts.** Schulz, M. (Aerospace Corp., El Segundo, CA (USA). Space Sciences Lab.). 28 Sep 1984. 45p. NTIS, PC A03/MF A01. File Number DE85901411.

This report reviews the status of radiation-belt science at the close of the data-acquisition phase (1976-1979) of the International Magnetospheric Study (IMS). The purpose is to place recent discoveries in context with respect to long-standing problems, and to indicate possible directions for future research in radiation-belt physics. The review includes a synopsis of results achieved on topics related to the source, energization, transport, and loss processes that affect geomagnetically trapped radiation, as well as results concerning certain subtle consequences of adiabatic charged-particle motion. Major areas of interest include the effects of charge exchange and radial transport on the ion composition of the ring current and radiation belts, the measurement of ion distributions in all three dimensions of velocity space, and the evolution of radiation-belt particle intensities as a consequence of temporal variations of transport coefficients and boundary conditions over the solar cycle and over the course of a magnetic storm. Moreover, the realization is developing that the major uncertainties in radiation-belt physics lie beyond the radiation belts themselves. These uncertainties include: (1) the problem of particle energization in the plasma sheet, which defines an outer boundary condition for the ring current and radiation belts; (2) the problem of particle energization in solar flares and in Jupiter's magnetosphere, both of which seem to constitute sources for the earth's radiation belts; and (3) the relationship of large-scale electric- and magnetic-field fluctuations across the magnetosphere to interplanetary parameters and geomagnetic indices that vary with time.

32466 **Poleward leap of the auroral electrojet as seen in auroral images.** Hones E.W. Jr. (University of California, Los Alamos National Laboratory, New Mexico). *Journal of Geophysical Research;* **90**: No. A6, 5333-5337(1 Jun 1985).

This paper discusses a recently published series of 12 successive images of the northern auroral oval obtained by the University of Iowa's auroral imager on DE 1 during a substorm on November 8, 1981. The images showed a sudden (within <12 min) thickening and poleward expansion of the midnight sector of the oval that occurred at the "maximum epoch" of the substorm, i.e., as auroral zone bays reached their peaks and began to subside about 90 min after the expansive phase onset. We propose that this was the auroral manifestation of the poleward leap of the auroral electrojet that has been reported on many occasions to coincide with thickening of the plasma sheet in the outer magnetotail (beyond ~15 R/sub E/) late in a substorm. The plasma sheet thickening is thought to be associated with a tailward retreat of the substorm magnetic neutral line. We note evidence that the neutral line's tailward retreat influences auroral currents and particle precipitation even at low auroral latitudes. Modifications of the present auroral substorm model are suggested.

32467 **Simulation study of type 2 counterstreaming electrons along auroral field lines.** Wagner, J.S.; Lin, C.S.; Tajima, T. (Sandia National Laboratory, Albuquerque, New Mexico). *Journal of Geophysical Research;* **90**: No. A5, 4249-4260(1 May 1985).

We examine the production of counterstreaming electrons associated with parallel fields along auroral field lines through the use of computer simulation. We use a 2 1/2 -dimensional (two spatial and three velocity dimensions) electrostatic particle algorithm and auroral boundary conditions to set up a self-consistent V potential structure. The simulation produces signatures of counterstreaming electrons resembling those observed by the Dynamics Explorer 1 (DE 1) satellite. The main signatures are as follows: (1) the phase space contours of the electron distribution function are elongated along the V/sub parallel/ axis, and (2) the energy of electrons streaming in the upward direction is comparable to the energy of the accelerated electron beam. The simulation indicates that a portion of the accelerated electron beam is trapped by large amplitude electrostatic waves produced through the two-stream instability. Strong wave-particle interactions then thermalize the trapped electrons to produce suprathermal electrons streaming in the direction opposite to that of the accelerated electron beam. These results suggest a possible mechanism of producing a counterstreaming electron fluxes through nonlinear processes of the two-stream instability.

32468 **Simulations of high—Mach-number collisionless perpendicular shocks in astrophysical plasmas.** Quest, K.B. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review Letters;* **54**: No. 16, 1872-1874(22 Apr 1985).

A problem of critical importance to space physics and astrophysics is the existence and properties of high—Mach-number shocks. In this Letter we present the preliminary results of a simulation of a perpendicular shock with Alfven Mach number 22. We show that for sufficiently small electron resistivity the dissipation for this shock is provided by a periodic, rather than time-stationary, reflection of ions. We discuss the problem of electron heating and the extension to higher Mach numbers.

32469 **Computer modeling of magnetotail convection.** Birn, J.; Schindler, K. (University of California, Los Alamos National Laboratory, Los Alamos, New Mexico). *Journal of Geophysical Research;* **90**: No. A4, 3441-3447(1 Apr 1985).

We studied the dynamic evolution of the geomagnetic tail in response to a dawn-to-dusk electric field E/sub y/ applied at the high-latitude boundary by means of a two-dimensional nonlinear MHD code. We found that the electric field propagates inward through the lobes toward the plasma sheet. Only a small fraction, however, penetrates into the interior of the plasma sheet, and eventually an almost linear decrease from the boundary to the equatorial plane is assumed. There was no tendency to evolve toward a steady or nearly steady state which would require E/sub y/ roughly-equal const in a larger area. The resulting time-dependent changes are consistent with quasi-static analytic models of Schindler and Birn (1982) and Birn and Schindler (1983) and with observed substorm growth phase effects in the near tail. If the external electric field E/sub y/ is constant or varies only slightly along the tail, the convection speed within the plasma sheet remains small. A strongly nonuniform external electric field E/sub y/ leads to similar spatial and temporal variation of E/sub y/. It does, however, produce a locally much stronger thinning which favors the onset of a tail instability such as the tearing mode. It can also produce stronger flows primarily parallel to the magnetic field.

32470 **Coupling of Newborn ions to the solar wind by electromagnetic instabilities and their interaction with the bow shock.** Winske, D.; Wu, C.S.; Li, Y.Y.; Mou, Z.Z.; Guo, S.Y. (Los Alamos National Laboratory, New Mexico). *Journal of Geophysical Research;* **90**: No. A3, 2713-2726(1 Mar 1985).

The process by which the solar wind assimilates newly ionized atoms is important for understanding the presence of planetary or interstellar helium in the solar wind, the dynamics of the Active Magnetospheric Particle Tracer Explorers (AMPTE) lithium releases in front of the earth's bow shock, and the formation of cometary tails. In this paper we examine how newborn ions can be coupled to the solar wind in the direction parallel to the magnetic field by means of electromagnetic instabilities driven by the distribution of newborn ions. The linear properties of three instabilities are analyzed and compared with numerical solutions of the linear dispersion equation, while their nonlinear behavior is followed by means of computer simulation to obtain the characteristic time for the pickup process. With a primary emphasis on the AMPTE lithium releases, various degrees of realism are introduced into the calculations to model the upstream conditions and the intersection of the lithium with the bow shock. It is shown that a time-dependent shock model is needed to correctly reproduce the amount of lithium which is transmitted through the shock and that the resulting lithium ion distribution is still likely to be subject to the same type of instabilities in the magnetosheath. Application of these results to comets, in particular the artificial comet expected to be generated by the AMPTE barium release in the magnetosheath, is also briefly discussed.

32471 **Slow-mode shocks: A semipermanent feature of the distant geomagnetic tail.** Feldman, W.C.; Baker, D.N.; Bame, S.J.; Birn, J.; Gosling, J.T.; Hones E.W. Jr.; Schwartz, S.J. (Los Alamos National Laboratory, University of California, Los Alamos, New Mexico). *Journal of Geophysical Research;* **90**: No. A1, 233-240(1 Jan 1985).

A survey is made of the relative frequency of encounters with slow-mode shocks observed by ISEE 3 in the distant geomagnetic tail. The association of these shocks with the phase of substorm activity as evidenced by enhanced currents in the auroral ionosphere and enhanced energetic-particle populations at geostationary orbit is also documented. During the 25 days between January 18 and February 11, 1983, 26 unambiguous examples of slow shocks were observed. Although a very strong association with the level of geomagnetic activity is found, shocks were observed during all phases of substorm activity including one during quiet conditions. Slow-mode shocks must therefore be a semipermanent feature of the bounding surfaces which separate lobe and plasma sheet particle populations in the distant geomagnetic tail.

32472 **Gyrating ions and large-amplitude monochromatic MHD waves upstream of the earth's bow shock.** Thomsen, M.F.; Gosling, J.T.; Bame, S.J.; Russell, C.T. (Los Alamos National Laboratory, New Mexico). *Journal of Geophysical Research;* **90**: No. A1, 267-274(1 Jan 1985).

Episodes of nearly monochromatic, low-frequency ($\sim$0.03 hz) hydromagnetic waves are occasionally observed upstream of the earth's bow shock. These waves have previously been associated with suprathermal ions of the "intermediate" type of distribution and have been attributed to the early stage of disruption of a field-aligned ion beam through the electromagnetic ion beam instability. However, high time resolution (3 s) measurements of two-dimensional ion distributions during two nearly monochromatic wave events reveal that the ion distributions associated with these waves are, in fact, "gyrating ions." Such distributions consist of suprathermal ions with parallel and perpendicular velocities confined to a fairly narrow range of (nonzero) values. The ions are also often confined to a fairly narrow range of gyrophase angle ("gyrophase bunched"). In one of the two cases, the observed frequency of the waves agrees quite well with the Doppler shifted resonance frequency of waves in right-hand resonance with the observed gyrating ions. In the second case, the observed frequency is lower than the predicted frequency by a factor of $\sim$1.5—2.

32473 **Solar wind variations and geomagnetic storms: A study of individual storms based on a high time resolution ISEE-3 data.** Akasofu, S.h.; Olmsted, C.; Smith, E.J.; Tsurutani, B.; Okida, R.; Baker, D.N. (Geophysical Institute, University of Alaska, Fairbanks). *Journal of Geophysical Research;* **90**: No. A1, 325-340(1 Jan 1985).

We employ two independent methods to determine the relationship between the ϵ parameter and the total energy dissipation rate of the magnetosphere by selecting disturbed periods from the same data set used by Baker et al. (1983). Specifically, four storms are examined in detail, since the accuracy of estimating U/sub T/ is significantly improved during disturbed periods. The first method assumes U/sub T/ = M/sub A//sup 2alpha/ϵ, where M/sub A/ is the Alfven Mach number and α varies with time. The second method considers a linear, time-invariant dynamic system with ϵ as input and U/sub T/ as output. This means U/sub T/ = W*ϵ, where * is convolution and W is a transfer function characteristic of the system. It is found that α values fluctuate mainly between 0 and -0.25. The transfer function analysis indicates that W often resembles a δ-function or a narrow rectangular impulse. Both results give the same implication (namely, U/sub T/ $\sim\epsilon$) and thus are consistent with the view that the magnetosphere is primarily a directly driven system during disturbed periods.

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32474 **(AD-A—151301/9/XAB) High current beam hollowing instability study. Final technical report.** Ekdahl, C.A. (Mission Research Corp., Albuquerque, NM (USA)). Jan 1985. 47p. NTIS, PC A03/MF A01.

High-current relativistic electron beams propagating in air are subject to a variety of macroscopic resistive instabilities, including hollowing, hose, and filamentation. Although the hose instability typically dominates experiments, computer simulations indicate that hollowing is potentially very disruptive to fast-current-risetime beams, especially at low air density. There have been at least three experiments that exhibited the hollowing instability clearly. Results from the last of these, performed using the 4-MeV, 70-kA IBEX beam generator, are analysed. The instability occurs routinely in computer simulations for beam currents above 17 kA and risetimes less than a few ns in full-density air, and over broader parameter ranges at reduced air densities. It develops rapidly in the beam nose and is highly disruptive. Although emittance tailoring and electron energy spread can raise the threshold for the onset of hollowing, the stability of high-current beams against hollowing can be assured only by maintaining a sufficiently long current risetime. A series of three high-current beam experiments have been performed to confirm this theoretical picture of the hollowing instability.

32475 **(AD-A—151763/0/XAB) Theory of electron-impact atomic ionization cross sections. Annual summary report, 1 July 1984-30 June 1985.** Girardeau, M.D. (Oregon Univ., Eugene (USA)). Mar 1985. 8p. NTIS, PC A02/MF A01.

The research underway is concerned with both the general theory and detailed calculations of differential cross sections for charge exchange and electron impact ionization occurring in collisions of simple atomic, ionic, and molecular species.

32476 **(AD-A—151958/6/XAB) Population inversion in laser-initiated vacuum arcs. Annual report, 1 February 1984-31 January 1985.** Krishnan, M. (Yale Univ., New Haven, CT (USA)). 25 Jan 1985. 54p. NTIS, PC A04/MF A01.

A detailed study of resonant photo-excitation of CII ions in a vacuum arc discharge by line radiation from laser-produced, AlIII ions was completed. Although enhanced fluorescence by up to a factor of eight in CII at 2138 A was observed, the collisional-radiative kinetics are such as to prevent a population inversion from building up under the conditions of the experiments. This unfavorable conclusion prompted the identification of a new class of Be-like, photo-excited lasers with potential laser wave-lengths from 2177 A in CIII down to 230 A in MgIX. Design considerations for such lasers are presented. Initial experiments in CIII pumped by MnVI line radiation have shown fluorescence enhancements in CIII at 2177 A by up to a factor of 150. Optimization of the pump plasma geometry has increased this enhancement to a factor of 500. Gain estimates are given which suggest that a laser can be constructed at 2177 A.

32477 **(AD-A—152001/4/XAB) Studies of collisional and nonlinear radiative process for development of coherent uv and xuv sources. Final report, November 1983-November 1984.** Rhodes, C.K.; Pummer, H.; Egger, H. (Illinois Univ., Chicago (USA). Dept. of Physics). Nov 1984. 116p. NTIS, PC A06/MF A01.

The availability of recently developed high-brightness picosecond rare-gas halogen sources permits the performance of a broad range of basic physical studies of high-lying electronic states of atomic and molecular materials. Moreover, the extension of the ultraviolet source technology to the femtosecond range will enable the generation of extreme physical environments, namely, coherent irradiation with an electric field amplitude, that are impossible to establish by any other known means. Experiments conducted over the past year indicate that it may be feasible to examine the detailed properties of states in a wide variety of systems in the region above 100 eV, and even possibly into the 1000 range of excitation, with these new experimental tools. The excited configurations of principal interest are those coupled to adjacent continua, prominent members of which are multiply excited and core excited states. The nature of intra-atomic interactions, including collective motions, figures naturally and importantly in this topic.

32478 **(BNL—36483) Cooling high intensity atomic hydrogen beams to liquid helium temperatures.** Hershcovitch, A.; Kponou, A.; DeVito, B.; Meier, R.; Kovarik, V.; Sluyters, T. (Brookhaven National Lab., Upton, NY (USA)). 1985. Contract AC02-76CH00016. 3p. (CONF-850504—122). NTIS, PC A02/MF A01; GPO Dep. File Number DE85012515.

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

An atomic hydrogen source, designed to operate in the viscous flow range, has been built at BNL. A unique feature of this source is a miniature gap between a teflon tube which guides the beam and an accommodator which cools it. Across this gap a step-function in temperature, with the teflon temperature exceeding 100°K and the accommodator temperature below 8°K, was successfully maintained. This configuration collimates the beam enough to prevent significant diffusive losses without subjecting it to the temperature range of high recombination. Initial results with an orifice of only one-tenth the dissociator aperture are indicative of particle density in the beam of well above 10^{10} cm^{-3}. 4 refs., 1 fig.

32479 **(CERN-EP—83-120) Search for exotic decays of orthopositronium.** Amaldi, U.; Carboni, G.; Dahme, W.; Owen, D.L. (European Organization for Nuclear Research, Geneva (Switzerland)). 18 Aug 1983. 7p. (CONF-830718—34). NTIS (US Sales Only), PC A02/MF A01. File Number DE85900998.

From International Europhysics conference on high energy physics; Brighton, UK (20 Jul 1983).

Light neutral particles such as axions could be emitted in orthopositronium annihilation: $e^+e^-(^3S_1) \rightarrow a^0\gamma$. Status and perspectives of an experiment to observe such decays are discussed.

32480 **(CONF-850560—4) Exit channels of autoionization resonances in atoms.** Krause, M.O. (Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85012299.

From Workshop on autoionization of atoms and small molecules; Argonne, IL, USA (2 May 1985).

In many-electron atoms with open shells strong autoionization resonances occur when an electron from an inner, weakly bound subshell is excited. Usually, the resonance state lies above several ionization thresholds and, hence, will decay into more than one exit or continuum channel. Several cases are discussed in which the resonance state is induced by synchrotron radiation, and the exit channels are differentiated and characterized by the analysis of the ejected electrons.

32481 **(CONF-8504136—1) Experimental x-ray scattering cross sections for H_2 and rare atomic gases.** Ice, G.E. (Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 23p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85011572.

From New directions in X-ray scattering workshop; Asilomar, CA, USA (3 Apr 1985).

Slides are presented for a talk on x-ray scattering from rare gases as an unambiguous test of ab initio wave functions and theoretical x-ray scattering cross sections.

32482 **(CTA-IEAV-RP—02/84) High-resolution spectroscopy of the N_2O in the far infrared using a tunable diode laser.** Torres Filho, A. (Centro Tecnico Aeroespacial, Sao Jose dos Campos (Brazil). Inst. de Estudos Avancados). Mar 1984. 317p. (In Portuguese). NTIS (US Sales Only), PC A14/MF A01. File Number DE85701410.

The high resolution spectroscopy of the N_2O molecule in the 17,5 to 15,8 μm (570 to 630 cm^{-1}) region was analysed using a tunable diode laser spectrometer (Spectro-Physics, model SP-5000). The main goal for this study is the use of the various well-known N_2O absorption lines as calibration standard for the precise determination of absorption line positions of other molecules, in the same spectral region.

32483 **(DESY—85-002) Comment on 'Path integral solution for a Mie-type potential'.** Steiner, F. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Jan 1985. 13p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85751633.

We comment on several incorrect results given in a recent paper by Erkoc and Sever (ES). In particular, it is pointed out that their path integral formula for the one-dimensional Mie-Lennard-Jones potential is wrong, since a quantum correction proportional to $(h/2\pi)^2$ - which is a consequence of the stochastic nature of the Feynman paths - has been overlooked. The correct expression can be obtained from a general path integral formula, which we have derived in a previous paper. For the particular potential discussed in detail by ES, we give a complete path integral treatment, which allows us to derive the energies and normalized wave functions of the discrete spectrum.

32484 **(DOE/ER/13137—T1) Generation of stimulated emission in the soft x-ray range by nonlinear processes with excimer lasers. Progress report, October 1, 1984-May 15, 1985.** Rhodes, C.K.; Boyer, K.; Luk, T.S.; Johann, U.; Schwarzenbach, A.P. (Illinois Univ., Chicago (USA). Dept. of Physics). 1985. Contract AC02-83ER13137. 36p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85012465.

Studies of multiphoton ionization of atoms have revealed several unexpected characteristics. The confluence of the experimental evidence leads to the hypothesis that the basic character of the atomic response involves highly organized coherent motions of entire atomic shells. The important regime, for which the radiative field strength E is greater than an atomic unit ($e/a_0{}^2$), can be viewed in approximate correspondence with the physics of fast (~10 MeV/amu) atom-atom scattering. This physical picture provides a basis for the expectation that stimulated emission in the x-ray range can be produced by direct highly nonlinear coupling of ultraviolet radiation to atoms. 53 refs., 8 figs.

32485 **(DOE/ER/45130—T1) Non-empirical interatomic potentials for transition metals. [Progress report].** (Washington Univ., St. Louis, MO (USA)). 07 Jun 1985. Contract FG02-84ER45130. 7p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85013448.

Research is reported in the study of metallic bonding and interatomic potential functions. Topics covered include many-atom interactions and the notion of an effective pair potential in a metal, interactions between transition metal ions in semiconductors and insulators, mathematical techniques for extrapolation from incomplete information about atomic distribution functions, and bonding and electronic structure of filled d-band tetrahedral compounds. (GHT)

32486 **(FIAS-R—131) Interpretation of intensities in electron-momentum and photoelectron spectroscopies.** McCarthy, I.E. (Flinders Univ. of South Australia, Bedford Park. Inst. for Atomic Studies). Jun 1984. 40p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85700986.

Relative intensities for the photoelectron reaction on atoms and molecules are not related to structure calculations in the same way as those for the noncoplanar symmetric (e,2e) reaction. The photoelectron dipole matrix element is dependent on recoil momentum only through its unique relationship to the photon energy and is much harder to calculate for chemically-interesting momenta. Relative intensities for binary (e,2e) reactions are independent of total energy at high enough energies and strongly dependent on symmetry and recoil momentum, for which an intensity profile can be measured for values starting at zero. In comparing with structure calculations, binary (e,2e) intensities for low recoil momentum may be compared directly with pole strengths in calculations of the one-electron Green's function or corresponding configuration-interaction calculations. In the case of states within a single symmetry manifold the relative intensities will be independent of recoil momentum up to some maximum, usually at least a few atomic units.

32487 (FRNC-TH—1918) **Study and characterization of a phosphorous ion source and development of a emittance-meter suited to multi-beam ion sources.** Hoang Gia Tuong. (Nancy-1 Univ., 54 (France)). Dec 1982. 97p. (In French). NTIS (US Sales Only), PC A05/MF A01. File Number DE85751343.

The ionization process which is used is the electronic bombardment. Phosphorus choice for the source experimentation is motivated by its principal destination: ionic implantation. Heavy ion applications are also quoted. Operating conditions allowing good results to be obtained are determined after a study of different parameters such as the electron current, the neutron pressure and the extraction voltage: the ion current obtained is of the order of mA. The source emittance, representing the quality of the ionic beam, is measured by a method suited to multibeam sources.

32488 (GSI—84-60-Prepr.) **Positron emission from the supercritical vacuum.** Kienle, P. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Oct 1984. 25p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85751122.

During the last years systematic experiments to study the pair creation in heavy ion-atom collisions were carried out using ^{208}Pb, ^{232}Th and especially ^{238}U beams from UNILAC heavy ion facility of the GSI in Darmstadt. While most experiments focused on bombarding energies around the Coulomb barrier some exploratory studies of positron production in deep inelastic reactions were reported. In this contribution our attention will be directed on reactions at the Coulomb barrier, in which unexpectedly positron lines at around 300 keV kinetic energy with a line width of about 60 keV were observed. The study of the characteristic features of these lines will be reported especially also in context with the suggestion that they originate from spontaneous positron decay of the overcritical vacuum of rather longlived (proportional 10^{-20}s) giant nuclei with $182<=Z<=188$.

32489 (GSI—84-64-Prepr.) **Bound electrons in critical magnetic fields.** Schlueter, P.; Soff, G.; Wietschorke, K.H.; Greiner, W. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Oct 1984. 32p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85780952.

We determined the threshold for spontaneous electron-positron pair creation for various combinations of a nuclear Coulomb field and an external homogeneous magnetic field. The dependence of electron binding energies of the nuclear charge and the magnetic field strength is investigated. Our exact solutions of the Dirac equation are compared with approximative methods valid for weak and rather strong magnetic fields.

32490 (GSI—84-65-Prepr.) **Calculations of deeply bound pionic states in heavy and superheavy atoms.** Friedman, E.; Soff, G. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Oct 1984. 14p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85780953.

Binding energies and widths of pions bound in the 1s-state of heavy and superheavy atoms are evaluated. The repulsive strong interaction lowers the Coulomb binding energy by up to 50%. The energy width of the strongest bound state investigated becomes comparable with the binding energy. No drastic consequence on the pion propagation in nuclear matter is expected.

32491 (INIS-mf—9632, pp 9) **Anomalous strong interaction in pionic atoms of Mg and Al.** Achard van Enschut, J.F.M. d' (Technische Hogeschool Delft (Netherlands)); Berkhout, J.B.R. (Vrije Univ., Amsterdam (Netherlands)); Duinker, W. (Nationaal Inst. voor Kernfysica en Hoge-Energiefysica (NIKHEF), Amsterdam (Netherlands). Sectie K). 19 Oct 1984. NTIS (US Sales Only), PC A02/MF A01. File Number DE85780923. (CONF-8410253—Summ.).

From Autumn meeting of the Dutch Association of Physics; Petten, Netherlands (19 Oct 1984).

Published in summary form only.

32492 (INIS-mf—9632, pp 9) **Pionic and muonic X-ray studies of ^{237}Np.** Achard van Enschut, I.F.M. d' (Technische Hogeschool Delft (Netherlands)); David, P. (JSKP Bonn); Duinker, W. (Nationaal Inst. voor Kernfysica en Hoge-Energiefysica (NIKHEF), Amsterdam (Netherlands). Sectie K). 19 Oct 1984. NTIS (US Sales Only), PC A02/MF A01. File Number DE85780923. (CONF-8410253—Summ.).

From Autumn meeting of the Dutch Association of Physics; Petten, Netherlands (19 Oct 1984).

Published in summary form only.

32493 (JAERI-M—84-005) **X-ray photoelectron and x-ray-induced Auger electron spectroscopic data, 1. 3d transition-metals (Sc, Ti, V, Ni) and related oxides.** Baba, Yuji; Sasaki, T.A. (Japan Atomic Energy Research Inst., Tokyo). Feb 1984. 43p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85700988.

The intrinsic data of the X-ray photoelectron spectra (XPS) and X-ray-induced Auger electron spectra (XAES) for 3d transition-metals and related oxides were presented. The clean surfaces of the metals were obtained by two different methods ; mechanical filings and Ar^+ ion etchings. The oxides examined are typical compounds such as Sc_2O_3, TiO_2, V_2O_5 and NiO. The report consists of 4 wide scans, 26 core-line spectra, 10 valence-band spectra and 20 XAES spectra. The peak positions of the core-lines and the Auger lines were summarized in 8 tables together with their chemical shifts.

32494 (JINR—R-2-83-899) **Hidden symmetry, separation of variables and interbasis expansions in the two-dimensional hydrogen atom.** Mardoyan, L.G.; Pogosyan, G.S.; Sisakyan, A.N.; Ter-Antonyan, V.M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1983. 18p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85700985.

Submitted to the journal J. Phys., A.

A group of hidden 0/3/ symmetry of the discrete spectrum of the two-dimensional hydrogen atom is determined on the basis of the method of separation of variables. Expansions for each fundamental basis of this group over two others are found and an additional integral of motion corresponding to an elliptic basis is determined. Representations of the elliptic basis as a superposition of polar and parabolic states are obtained. Certain interesting limiting cases are investigated.

32495 (KEK—82-14, pp 87-88) **Rutherford scattering applied to the study of hydrogen in amorphous silicon.** Yanokura, M.; Nagai, H.; Aratani, M.; Nozaki, T.; Kohno, I. (Institute of Physical and Chemical Research, Wako, Saitama (Japan)). Jan 1983. (In Japanese). NTIS (US Sales Only), PC A11/MF A01. File Number DE85781031. (CONF-8208206—Summ.).

From 7. meeting on linear accelerators; Oho, Ibaraki, Japan (24 Aug 1982).

Published in summary form only.

32496 (LA-UR—85-1606) **Beam potential measurement of an intense H^- beam by use of the emissive probe technique.** Sherman, J.D.; Allison, P.; Smith, H.V. Jr. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 4p. (CONF-850504—65). NTIS, PC A02/MF A01; GPO Dep. File Number DE85012671.

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

An emissive probe has been developed to study the beam-plasma potential generated by a 20-keV, 30-mA/cm^2 quiescent H^- beam propagating in Xe background gas. An axial ion trap has been built, and its influence on the measured potentials is reported. The peak plasma potential at 10^{13} cm^{-3} Xe density increased from +5V to +10V when the ion-trap voltage was increased from zero to +80V. The quiescent H^- beam rms emittance, measured 34 cm from the ion source, increased from 0.012 to 0.023 π x cm x mrad when the Xe density was decreased from 2.2 x 10^{12} cm^{-3} to zero. 8 refs., 3 figs.

32497 (NAC-AR—84-01, pp 187-189) **Report of the Van de Graaff Group: atomic physics. Beam-foil spectroscopy of single-ionized oxygen.** Coetzer, F.J.; Kotze, T.C.; Mostert, F.J.; Van der Westhuizen, P. (Stellenbosch Univ. (South Africa)). 1984. NTIS (US Sales Only), PC A14/MF A01. File Number DE85780939.

Short note.

In Annual report June 1984. [Council for Scientific and Industrial Research, Faure (South Africa). National Accelerator Center].

32498 (NAC-AR—84-01, pp 185-187) **Report of the Van de Graaff Group: atomic physics. Radiative lifetimes in Kr III.** Coetzer, F.J.; Kotze, T.C.; Van der Westhuizen, P. (Stellenbosch Univ. (South Africa)). 1984. NTIS (US Sales Only), PC A14/MF A01. File Number DE85780939.

Short note.

In Annual report June 1984. [Council for Scientific and Industrial Research, Faure (South Africa). National Accelerator Center].

32499 (NAC-AR—84-01, pp 182-184) **Report of the Van de Graaff Group: atomic physics. Beam-foil mean lifetime in Kr II obtained.** Coetzer, F.J.; Kotze, T.C.; Van der Westhuizen, P. (Stellenbosch Univ. (South Africa)). 1984. NTIS (US Sales Only), PC A14/MF A01. File Number DE85780939.

Short note.

In Annual report June 1984. [Council for Scientific and Industrial Research, Faure (South Africa). National Accelerator Center].

32500 (NAC-AR—84-01, pp 176-181) **Report of the Van de Graaff Group: atomic physics. Inner-shell excitation mechanisms in ion-atom collisions.** Shanker, R.; Bilau, R.; Hippler, R.; Lutz, H.O. (Bielefeld Univ. (Germany, F.R.)); Wille, U. (Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (Germany, F.R.)); McMurray, W.R. 1984. NTIS (US Sales Only), PC A14/MF A01. File Number DE85780939.

In Annual report June 1984. [Council for Scientific and Industrial Research, Faure (South Africa). National Accelerator Center].

The study deals with krypton L-shell excitation in Kr-Kr and Kr-Xe collisions. Krypton L-shell vacancy production in slow Kr-Kr and Kr-Xe collisions has been investigated both experimentally and theoretically. Impact parameter dependent vacancy production rates have been obtained for Kr-Kr collision energies of 0,7 1,05 1,4 MeV and for Kr-Xe collision energies of 0,7 1,05 and 1,4 MeV. The differential cross sections for Kr-L excitation in Ar-Kr collisions and the total cross sections for Kr L-shell vacancy production were determined.

32501 (NRCN—544) **Calculation of collisional angular-momentum mixing of Rydberg states.** Oreg, J.; Strauss, M.; Hazak, G. (Israel Atomic Energy Commission, Beersheba. Nuclear Research Center-Negev). Sep 1983. 13p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85701411.

Exact solutions of the coupled differential equations for collisional mixing probabilities are presented for a sodium-helium system. The results show that complete mixing is not reached in this model. The main contribution to the collisional mixing cross-section of the sodium "nd" state comes from impact parameters b within the range $n^2<=b<=2n^2$. The total cross-sections obtained are in agreement with the experiment.

32502 (ORNL/TM—9501) **Electron impact ionization of multicharged ions at ORNL: 1980-1984.** Gregory, D.C.; Crandall, D.H.; Phaneuf, R.A.; Howald, A.M.; Dunn, G.H.; Falk, R.A.; Meuller, D.W.; Morgan, T.J. (Oak Ridge National Lab., TN (USA)). May 1985. Contract AC05-84OR21400. 97p. NTIS, PC A05/MF A01; GPO Dep. File Number DE85013104.

Experimental electron-impact ionization cross sections for thirty-seven target ions are presented, summarizing measurements made at ORNL during the period from 1980 through early 1984. Target ions range in atomic number from Z = 5 (boron) to Z = 73 (tantalum), with charge states ranging from +2 through +6 and energies ranging from below the ionization threshold to 1500 eV in most cases. All data are presented in both tables and graphs. Maxwellian ionization rate coefficients are tabulated over the equivalent temperature range 10 to 3000 eV, and fitting parameters are given to allow the calculation of rates at intermediate electron temperatures or for inclusion in computer programs for plasma modeling.

32503 (PUC-TN—09/83) **Electrons in crossed laser and magnetic fields: an exactly soluble model in QED.** Davidovich, L.; Rochlin, H. (Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Fisica). Jun 1983. 9p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85701412.

The interaction of an electron with a static and uniform magnetic field B sup(→), in the presence of the quantized electromagnetic field, is studied by means of an exactly soluble model, which allows the study of the line shape of the scattered radiation in the resonance region, with spontaneous emission effects taken into account. The model also allows an exact renormalization procedure, after which the calculated spectrum remains finite, in the point-electron limit. In particular it is found, in this limit finite expressions for the linewidth and the energy shift of the scattered radiation, as functions of B. Explicit expressions for the electron and field operators are also found, and the correspondence of these results with classical solutions is discussed.

32504 (PUC-TN—10/83) **High-intensity ionization approximations: test of convergence in a one-dimensional model.** Antunes Neto, H.S.; Davidovich, L.; Marchesin, D. (Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Fisica). Jun 1983. 9p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85701413.

By solving numerically a one-dimensional model, the range of validity of some non-perturbative treatments proposed for the problem of atomic ionization by strong laser fields is examined. Some scaling properties of the ionization probability are established and a new approximation, which converges to the exact results in the limit of very strong fields is proposed.

32505 (PUC-TN—17/83) **Direct Coulomb ionization of the 1s σ molecular orbital by slow heavy projectiles following hyperbolic paths.** Montenegro, E.C.; Sigaud, G.M. (Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Fisica). Jun 1983. 9p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85701414.

Briggs united-atom model is used to derive the direct Coulomb ionisation cross-section of the 1s σ molecular orbital by slow projectiles following hyperbolic paths.

32506 (PUC-TN—28/83) **Nonperturbative treatment of decaying states.** Nussenzveig, H.M. (Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Fisica). Oct 1983. 33p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85701415.

An exactly soluble model of a multilevel atom interacting with the quantized radiation field is treated. The general solution for the resolvent matrix elements in the sector of interest is obtained. The solution is explicitly evaluated when the interaction matrix elements are the exact ones associated with a nonrelativistic hydrogen atom, including retardation. The analytic properties of the resolvent are discussed. The results are applied to derive the time evolution of a Weisskopf-Wigner initial state and the resonance scattering of an incident photon wave packet by the atom, including radiative level shifts.

32507 (SAND—84-2065C) **Electron and photon stimulated desorption from organic molecular solids: final state leading to desorption.** Kelber, J.A. (Sandia National Labs., Albuquerque, NM (USA)). 1984. Contract AC04-76DP00789. 7p. (CONF-8410274—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE85004651.

From Diet II conference; Elmau, F.R. Germany (14 Oct 1984).

The results discussed here for both fluoroalkanes and neopentane illustrate how useful a systematic variation of chemical structure can be in investigating desorption mechanisms. Condensed thin films of large organic molecules are obviously ideal for this purpose. Additional benefits include the ability to avoid charging by using a sufficiently thin film on a metal substrate and the relative ease of preparing a fresh surface after damage by electron or photon bombardment. One must, however, exercise some caution in extending results from experiments performed on such materials to real world extended systems such as polymers and semiconductor surfaces. The effect of system size on desorption mechanisms is not well understood, and much work in this area can be anticipated in the near future. 23 refs., 4 figs.

32508 (UCRL—15671) Atomic processes in electron beam channels. Final report, November 13, 1981-October 30, 1983. Bardsley, J.N. (Pittsburgh Univ., PA (USA)). 11 May 1984. Contract W-7405-ENG-48. 17p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85012972.

Calculations are presented of the rate of dissociative recombination of electrons with NO^+ ions. The computed rates agree with measured values at room temperature and lie between conflicting experimental values at high temperature. The effect of these calculations on the residual electron density in particle beam channels is discussed.

32509 (UCRL—92713) Mean life of the $2p^4(^1S)3s$ ^2S state in fluorine. Cheng, K.T.; Chen, M.H. (Lawrence Livermore National Lab., CA (USA)). 17 May 1985. Contract W-7405-ENG-48. 5p. (CONF-850560—5). NTIS, PC A02/MF A01; GPO Dep. File Number DE85012929.

From Workshop on autoionization of atoms and small molecules; Argonne, IL, USA (2 May 1985).

In this work, we calculate the radiationless as well as the radiative decay rates for the $2p^4(^1S)3s$ ^2S state. For comparison purposes, we also make similar calculations for the $2p^4(^1D)4s$ ^2D state. Our calculation is based on the multi-configuration Dirac-Fock (MCDF) method. As spin-orbit interaction is built in, this method is capable of studying LS forbidden Auger transitions. Details of the Auger transition calculations have been given before. 9 refs.

32510 Structure and predissociation dynamics of electronically excited nitrogen dioxide: A resonance Raman study. Rohlfing, E.A.; Valentini, J.J. (Chemistry Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Chemical Physics;* **83**: No. 2, 521-528(15 Jul 1985).

Resonance Raman spectra of NO_2 have been recorded as a function of excitation frequency in the range 0—8000 cm^{-1} above the predissociation threshold. These spectra are interpreted using the time-dependent formulation of resonant Raman scattering, to elucidate the shape of the excited electronic state potential energy surface, and the dynamics which occur on it immediately following photoexcitation. Our results show that the dominant optical transition in this spectral range is $^2B_2$—$^2A_1$. Our Raman spectra reveal a marked decrease in the dynamical time scale of the predissociation of the $^2B_2$ state as excitation frequency increases. At excitation frequencies approximately 4850 cm^{-1} above the dissociation threshold, the $^2B_2$ predissociative lifetime becomes comparable to a vibrational period. We have analyzed the resonance Raman spectra, along with the absorption spectrum, to determine the magnitudes of the slopes of the potential surface along the symmetric stretch and bending normal coordinates for the $^2B_2$ excited state in the Frank—Condon region.

32511 Quantum mechanical reactive scattering via exchange kernels: Infinite order exchange on a grid. Dardi, P.S.; Shi, S.; Miller, W.H. (Department of Chemistry, and Materials and Molecular Research Division of the Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Journal of Chemical Physics;* **83**: No. 2, 575-583(15 Jul 1985).

A general methodology is described for carrying out quantum mechanical reactive scattering calculations. The approach is based on Miller's [J. Chem. Phys. 50, 407 (1969)] formulation of quantum reactive scattering in which rearrangement processes (i.e., chemical reactions) are characterized by nonlocal exchange interactions that couple different arrangements. The specific approach described here requires that nonreactive coupled channel calculations first be carried out separately in the various arrangements: this is a relatively standard inelastic scattering problem: and the non-local exchange interactions are then discretized on a grid in (translational) coordinate space; straightforward linear algebra calculations then lead to the scattering matrix. (Discretizing the exchange kernels on a grid is suggested because exchange is very short range.) The attractiveness of the overall method is its straightforwardness, generality, and special suitability for the vector-processing character of modern supercomputers. Application to a standard test problem (the collinear $H+H_2$ reaction) shows that it is numerically stable over a wide range of collision energies.

32512 Study of the isomeric dependence of low-energy (<10 eV) electron attachment: Perfluoroalkanes. Spyrou, S.M.; Hunter, S.R.; Christophorou, L.G. (Atomic, Molecular, and High Voltage Physics Group, Health and Safety Research Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Journal of Chemical Physics;* **83**: No. 2, 641-654(15 Jul 1985). Contract AC05-84OR21400.

The attachment of low-energy (<10 eV) electrons to the open-chain i-C_4F_{10}, i-C_5F_{12}, neo-C_5F_{12}, and to the cyclic c-C_4F_8 and c-C_5F_{10} perfluoroalkanes has been studied using a time-of-flight mass spectrometer (TOFMS) and a high pressure electron swarm technique as well as the TOFMS results reported earlier on c-C_4F_8 and i-C_4F_{10}. Both long-lived parent anions (autodetachment lifetimes tau/sub a/ $>10^{-6}$ s) and dissociative attachment fragment anions were observed for these molecules in the mass spectrometric study. The relative cross sections for negative ion formation and the tau/sub a/ of the long-lived parent anions were measured as a function of electron energy in the mass spectrometric study. The absolute total electron attachment rate constants as a function of the mean electron energy have been measured in the swarm study and used to calculate the total electron attachment cross sections as a function of electron energy. Both studies have shown a strong dependence of dissociative and nondissociative electron attachment processes on the structure of the molecules studied. For neo-C_5F_{12}, the predominant anion is the fragment $C_4F^-{}_9$. In contrast, for i-C_4F_{10}, i-C_5F_{12}, c-C_4F_8, and c-C_5F_{10}, the parent anions are stronger than any of the fragment anions. Energetic considerations have been employed to identify fragmentation mechanisms of the negative ion states (NISs) leading to the formation of the observed fragment anions and to deduce some thermochemical data.

32513 Charge transfer: An electronic bath approach. McDowell, H.K. (Los Alamos National Laboratory, University of California, Los Alamos, New Mexico 87545). *Journal of Chemical Physics;* **83**: No. 2, 772-780(15 Jul 1985).

A charge transfer theory is developed for systems in which an atom, molecule, or ion interacts for a period of time with a substrate. The Hamiltonian of the system is taken to be one-electron and the nuclear motion of the substrate is ignored. The theory is structured so as to mimic generalized Langevin theory; namely, the equations of motion for annihilation operators of spin orbitals localized at the interaction site are developed such that a primary zone is defined with the remainder of the substrate being included through a memory kernel and a driving term. An electronic bath approximation is presented which leads to equations of motion for the occupation numbers of spin orbitals in the primary zone. These equations have the property that primary-zone occupation numbers damp to an equilibrium state at long time independent of their initial values. Specific application to a substrate modeled as a semi-infinite, Huckel chain is presented and numerical results are obtained. The electronic bath approximation is found to produce results in agreement with numerically exact data.

32514 Computation of two surface properties by coordinate-space propagator techniques. Coalson, R.D. (Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Chemical Physics;* **83**: No. 2, 688-697(15 Jul 1985).

The time-dependent two-surface formalism (used to calculate electronic absorption spectra, Raman excitation profiles, etc.) is recast so as to enable the employment of recently developed coordinate space propagator techniques in the computation of the relevant time kernels. Two classes of propagator methods are discussed in connection with the two-surface problem: matrix multiplication of discretized short-time propagators and Monte Carlo path integration. As a nontrivial test case, the matrix multiplication procedure is successfully utilized to extract a high resolution finite temperature electronic absorption spectrum involving displaced one-dimensional Morse wells.

32515 Rydberg states of the ArCO$_2$ and KrCO$_2$ van der Waals molecules. Dehmer, P.M. (Argonne National Laboratory, Argonne, Illinois 60439). *Journal of Chemical Physics;* **83**: No. 1, 24-33(1 Jul 1985). Contract W-31-109-ENG-38.

Relative photoionization cross sections were determined for ArCO$_2$ at a wavelength resolution of 0.24 A in the regions of both the Ar*+CO$_2$ and the Ar+CO($_2$ dissociation limits (690—920 A) and for KrCO$_2$ at a wavelength resolution of 0.4 A in the region of the Kr+CO($_2$ dissociation limits (690—780 A). The dimer ionization potentials are 13.59 +- 0.04 eV (912.5 +- 2.5 A) for ArCO$_2$ and 13.33 +- 0.04 eV (930.0 +- 3.0 A) for KrCO$_2$. Combining these values with the known value of the CO$_2$ ionization potential and the known (or estimated) values of the ArCO$_2$ and KrCO$_2$ dissociation energies yields values for the dimer ion ground state dissociation energies of 0.20 +- 0.04 eV for ArCO$^+{}_2$ and 0.47 +- 0.05 eV for KrCO$^+{}_2$. Rydberg structure is observed in the photoionization cross section of ArCO$_2$ corresponding to dissociation limits of the type Ar*(nd,ns)+CO$_2$; however, discrete structure is observed only near the Ar*(3d,5s)+CO$_2$ dissociation limits. van der Waals structure corresponding to the higher Ar*+CO$_2$ limits is diffuse and red degraded. Molecular Rydberg structure also is observed in the photoionization cross sections of both ArCO$_2$ and KrCO$_2$ corresponding to dissociation limits of the type Ar+CO($_2$.

32516 Measurement and analysis of the infrared-active stretching fundamental (νa) of UF$_6$. Aldridge, J.P.; Brock, E.G.; Filip, H.; Flicker, H.; Fox, K.; Galbraith, H.W.; Holland, R.F.; Kim, K.C.; Krohn, B.J.; Magnuson, D.W.; Maier W.B. II; McDowell, R.S.; Patterson, C.W.; Person, W.B.; Smith, D.F.; Werner, G.K. (University of California, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Chemical Physics;* **83**: No. 1, 34-48(1 Jul 1985).

High-resolution spectra of the infrared-active stretching fundamental ν_3 of ^{238}UF$_6$ have been obtained between 620.6 and 633.5 cm^{-1} using tunable semiconductor diode lasers. Interference from hot bands was suppressed by cooling the UF$_6$ in a supersonic expansion, and useful monomer concentrations were produced with effective temperatures of $<$100 K. Portions of the band from P(77) to R(66) are illustrated. All transitions from the vibrational ground state have been assigned, and the Q branch has been fully analyzed. A total of 43 line frequencies and 110 frequency differences extending in J to P(77), Q(91), and R(67) has been used to fit seven spectroscopic constants. The ground- and excited-state values of the rotational constant B could be individually determined, and the U—F bond length in the ground vibrational state is r_0 = 1.9962 +- 0.0007 A. The Q branch of ^{235}UF$_6$ has also been analyzed and the ^{235}UF$_6$—^{238}UF$_6$ ν_3 isotope shift measured to be 0.603 79 +- 0.000 17 cm^{-1}. The isotope shift and the Coriolis constant zeta$_3$ have been used to refine the general quadratic intramolecular force field of UF$_6$, and the Cartesian displacement coordinates of both infrared-active fundamentals are illustrated and compared with those of SF$_6$.

32517 Ab initio study of cyanogen: The X $^1u^+$/sub g/, a $^3\Sigma^+$/sub u/, B $^1\Delta$/sub u/, and C ^{1}Pi/sub u/ states. Dateo, C.E.; Dupuis, M.; Lester W.A. Jr. (Materials and Molecular Research Division, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Journal of Chemical Physics;* **83**: No. 1, 265-272(1 Jul 1985). Contract AC03-76SF00098.

An ab initio multiconfiguration Hartree—Fock (MCHF) study of the X $^1\Sigma^+$/sub g/, a $^3\Sigma^+$/sub u/, B $^1\Delta$/sub u/, and C ^{1}Pi/sub u/ states of cyanogen (C$_2$N$_2$) is presented. Equilibrium structures, harmonic vibrational frequencies, excitation energies, and dissociation energies have been calculated and found to be in semiquantitative agreement with available experimental data. This study confirms the $\pi \rightarrow \pi^*$ character of C$_2$N$_2$ (a $^3\Sigma^+$/sub u/) and C$_2$N$_2$ (B $^1\Delta$/sub u/), and the n $\rightarrow \pi^*$ character of C$_2$N$_2$ (C ^{1}Pi/sub u/) near their equilibrium structures. Configuration mixing among the n and π electrons is needed to correct the broken symmetry description given by the Hartree—Fock (HF) method, and leads to a qualitatively correct representation of these states. For C$_2$N$_2$ (a $^3\Sigma^+$/sub u/) and C$_2$N$_2$ (B $^1\Delta$/sub u/), the harmonic force constants show a strong through-bond interaction which is due to the dominance of the charge transfer configuration $^+$NCCN$^-$.

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32518 Vibrational energy transfer in HBr—C$_2$D$_2$ mixtures. Breshears, W.D.; Smith, I.W.M. (Department of Physical Chemistry, University Chemical Laboratories, Lensfield Road, Cambridge CB2 1EP, England). *Journal of Chemical Physics;* **83**: No. 1, 140-144(1 Jul 1985).

Infrared fluorescence from HBr and C$_2$D$_2$(ν_3) has been measured following irradiation of HBr—C$_2$D$_2$ mixtures with a pulsed HBr laser. The fluorescence decay from both species yields the total rate constant for deactivation of HBr(v = 1) by collisions with C$_2$D$_2$, k = (1.6 +- 0.1) x 10^4 s^{-1} Torr^{-1}. The exponential rise of C$_2$D$_2$(ν_3) fluorescence is characterized by the rate constants k = (3.4 +- 0.2) x 10^4 s^{-1} Torr $^{-1}$ for collisions with both C$_2$D$_2$ and HBr, and k = (5.5 +- 2.3) x 10^3 s^{-1} Torr^{-1} for collisions with added Ar. A model developed to fit the observations implies that ν_3 is populated indirectly by transfer from another, unidentified, level of C$_2$D$_2$, and that the exponential rise constants refer to transfer from ν_3 to this level.

32519 Vibrational excitation of CH$_3$F by collisions with "hot" H and D atoms. McGee, T.H.; Weston R.E. Jr.; Flynn, G.W. (Department of Chemistry, Brookhaven National Laboratory, Upton, New York 11973). *Journal of Chemical Physics;* **83**: No. 1, 145-148(1 Jul 1985). Contract AC02-78ER04940.

Hot hydrogen atoms have been produced by photolysis of HBr, HI, and H$_2$S at 193 nm, and HI at 248 nm; D atoms were produced by photolysis of D$_2$S at 193 nm. Vibrational excitation of CH$_3$F in collisions with these hot atoms has been observed by detection of infrared emission at 3.3 μm (ν_1, ν_4) and 9.6 μm (ν_3). Relative probabilities for excitation of these modes have been determined, and the ν_3/ν_1, ν_4 ratio is much larger than is predicted by simple impulsive models. The "isotope effect," i.e., relative excitation by H atoms compared to D atoms, is 1.4 for both vibrational modes.

32520 Detection of the bending fundamental band of DN$^+$Z by diode laser absorption spectroscopy. Sears, T.J. (Department of Chemistry, Brookhaven National Laboratory, Upton, New York 11973). *Journal of Chemical Physics;* **82**: No. 12, 5757-5758(15 Jun 1985).

The detection of 28 rotational lines in the bending fundamental band of DN$^+{}_2$ is reported. The spectra were obtained in a modulated discharge of D$_2$ and N$_2$ in a large hollow cathode which was cooled to liquid nitrogen temperature. Analysis leads to accurate values for the band origin and all of the major parameters describing the (01^{1}0) state of the ion.

32521 Photoelectron spectrum of ArXe obtained using resonantly enhanced multiphoton ionization. Pratt, S.T.; Dehmer, P.M.; Dehmer, J.L. (Argonne National Laboratory, Argonne, Illinois 60439). *Journal of Chemical Physics;* **82**: No. 12, 5758-5760(15 Jun 1985).

The photoelectron spectrum of the heteronuclear rare gas dimer ArXe was determined using resonantly enhanced multiphoton ionization-photoelectron spectroscopy (REMPI-PES). Three photoelectron peaks are observed corresponding to the production of ArXe$^+$ in the A$^2\Sigma^+$/sub 1/2/ B^{2}Pi$_3$/sub //$_2$, and B^{2}Pi$_1$/sub //$_2$ states. The kinetic energies of these peaks are used to determine lower limits for the dissociation energies of the ionic states.

32522 **State-to-state study of the symmetric charge transfer reaction Ar$^+$(^{2}P/sub 3/2,1/2/)+Ar(^{1}S$_0$).** Liao, C.; Liao, C.; Ng, C.Y. (Ames Laboratory, U. S. Department of Energy, and Department of Chemistry, Iowa State University, Ames, Iowa 50011). *Journal of Chemical Physics;* **82**: No. 12, 5489-5498(15 Jun 1985). Contract W-7405-ENG-82.

The relative state-to-state total charge transfer cross sections, σ/sub 3/2arrow-right3/2/, σ/sub 3/2arrow-right1/2/, σ/sub 1/2arrow-right1/2/, and σ/sub 1/2arrow-right3/2/, for the reactions Ar$^+$(^{2}P$_3$/sub //$_2$)+Ar(^{1}S$_0$) → Ar(^{1}S$_0$)+Ar$^+$(^{2}P$_3$/sub //$_2$)= GFIX → Ar(^{1}S$_0$)+Ar$^+$(^{2}P$_1$/sub //$_2$), Ar$^+$(^{2}P$_1$/sub //$_2$)+Ar(^{1}S$_0$) → Ar(^{1}S$_0$)+Ar$^+$(^{2}P$_1$/sub //$_2$) GFIX → Ar(^{1}S$_0$)+Ar$^+$(^{2}P$_3$/sub //$_2$), respectively, at the laboratory collision energy range of 1—4000 eV, have been determined using the newly constructed crossed ion—neutral beam

32523 **Evidence for uncorrelated electron capture and K-shell excitation in S^{13+} VHe collisions.** Tanis, J.A.; Bernstein, E.M.; Clark, M.W.; Graham, W.G.; McFarland, R.H.; Morgan, T.J.; Johnson, B.M.; Jones, K.W.; Meron, M. (Department of Physics, Western Michigan University, Kalamazoo, Michigan 49008). *Physical Review [Section] A: General Physics;* **31**: No. 6, 4040-4042(Jun 1985).

Evidence is presented for a two-step process in ion-atom collisions in which two independent interactions occur in a single encounter. Measurements for 15—200-MeVS^{13+} +He collisions indicate that uncorrelated projectile K-shell excitation and capture of a target electron occur in a single collision with one target atom. The results are in reasonable qualitative agreement with theoretical predictions of this two-step process.

32524 **New target cell design for alkali and alkaline earth vapor scattering experiments.** Coggiola, M.J.; Peterson, J.R.; Leon, R.L. (Chemical Physics Laboratory, SRI International, Menlo Park, California 94025). *Review of Scientific Instruments;* **56**: No. 6, 1248-1252(Jun 1985). Contract AT03-80ER53091.

A scattering cell is described that is suitable for use with targets of alkali and alkaline earth vapors in beam-static gas collision experiments. A novel feature of this vapor oven design is that the entire assembly can be rapidly moved into and out of the projectile beam path. When used with fixed beam defining apertures, this arrangement results in greatly simplified total scattering cross-section measurements using an attenuation technique. Examples of cross sections measured in this way are presented for electron capture and loss by D$^+$/D$^-$ in a Cs target between 0.1 and 4.0 keV/amu.

32525 **Effect of optical saturation on hyperfine intensities in optogalvanic spectroscopy.** Engleman R. Jr.; Keller, R.A.; Miller, C.M. (Chemistry Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of the Optical Society of America B: Optical Physics;* **2**: No. 6, 897-902(Jun 1985). Contract W-7405-ENG-36.

The hyperfine structure of the 22 125-cm^{-1}, ^{2}D/sup degree//sub 3/2/ ← ^{2}D/sub 3/2/ lutetium transition has been examined by both Fourier transform emission and laser optogalvanic spectroscopy. The component intensities of the Fourier-transform spectrum closely agree with classical intensities. The optogalvanic spectra show progressively larger deviations from classical intensities as the laser power is increased. Introduction of a single optical saturation parameter into the intensity formula is sufficient to fit the observed intensities even at high laser powers. These spectra were used to derive accurate values for the ^{175}Lu line origin, the upper-state hyperfine constants of ^{175} Lu, and the isotope shift between ^{176}Lu and ^{175} Lu.

32526 **Interpreting coherent anti-Stokes Raman spectra measured with multimode Nd:YAG pump lasers.** Farrow, R.L.; Rahn, L.A. (Combustion Research Facilities, Sandia National Laboratories, Livermore, California 94550). *Journal of the Optical Society of America B: Optical Physics;* **2**: No. 6, 903-907(Jun 1985).

We report comparisons of coherent anti-Stokes Raman spectroscopy (CARS) measurements using single-axial-and multiaxial-mode Nd:YAG lasers. Our results demonstrate the validity of a recently proposed convolution expression for unresolved CARS spectra. The results also support the use of a relative delay of several coherence lengths between pump-beam paths for reducing the effects of pump-field statistics on the CARS spectral profile.

32527 **Muonic atoms with vacant electron shells.** Bacher, R.; Gotta, D.; Simons, L.M.; Missimer, J.; Mukhopadhyay, N.C. (Kernforschungszentrum Karlsruhe, Institut fuer Kernphysik und Universitat Karlsruhe, Institut fuer Experimentelle Kernphysik, Karlsruhe, Federal Republic of Germany). *Physical Review Letters;* **54**: No. 19, 2087-2090(13 May 1985). Contract AC02-83ER40114.

We show that the cascade in muonic atoms with $Z<20$ ejects sufficient atomic electrons to ionize an isolated muonic atom completely. In gases, the rates with which electrons refill the atomic shell can be accurately deduced from measured and calculated electron transfer cross sections. Thus, we can conclude that completely ionized muonic atoms can be prepared in gases, and that they remain isolated for long enough times at attainable pressures to facilitate studies of fundamental interactions in muonic atoms.

32528 **Vibrational relaxation in H_2 molecules by wall collisions: Applications to negative ion source processes.** Karo, A.M.; Hiskes, J.R.; Hardy, R.J. (Lawrence Livermore National Laboratory, Livermore, California 94550). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **3**: No. 3, 1222-1228(May 1985). Contract W-7405-ENG-48.

In the volume of a hydrogen discharge, H_2 molecules, excited to high vibrational levels ($v''>6$), are formed either by fast-electron collisions or from $H^+{}_2$ ions that are accelerated across the discharge-wall potential that undergo Auger neutralization prior to impact with the discharge chamber wall. We have used computer molecular dynamics to study the deexcitation and reexcitation of vibrationally excited H_2 molecules undergoing repeated wall collisions. The initial translational energies range from thermal to 100 eV and the initial vibrational states range from $v'' = 2$ to $v'' = 12$. The average loss or gain of vibrational, rotational, translational, and total molecular energies and the survival rates of the molecules have been evaluated. At thermal energies vibrational deexcitation is the predominant process, and a consistent picture emerges of rapid energy redistribution into all the molecular degrees of freedom and a slower rate of loss of total molecular energy to the wall. At higher translational energies (1—100 eV) a substantial fraction of the molecules survives with large ($v''>6$) vibrational energy. This vibrational population provides a contribution to the total excited vibrational population comparable to that from the fast-electron collision process. Implications of these results for negative ion generation will be discussed.

32529 **Hydrogen vibrational population distributions and negative ion generation in tandem high density hydrogen discharges.** Hiskes, J.R.; Karo, A.M.; Willmann, P.A. (Lawrence Livermore National Laboratory, University of California, Livermore, California 94550). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **3**: No. 3, 1229-1233(May 1985). Contract W-7405-ENG-48.

The tandem high-density hydrogen negative-ion-source system is optimized to identify the largest possible ion concentrations and extracted ion currents. The optimization includes varying the length of the second chamber, varying neutral gas and electron densities, and varying the ratio of atomic to molecular density. Vibrational excitation occurs via high-energy electron excitation (E—V process) and $H^+{}_2$ surface neutralization (s—V process). These processes are considered separately and acting in parallel. The solutions are presented in terms of a dimensional scale factor R. For a system scale length R = 1 cm, optimum extracted current densities are in the range 50 to 100 mA cm^{-2}. A single-chamber s—V system with the high-energy electron component suppressed can provide larger ion concentrations than a tandem E—V, s—V system.

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32530 Observation of the *ν*Z (bending) fundamental of the HN_2^+ ion at 14.6 micrometers. Sears, T.J. (Department of Chemistry, Brookhaven National Laboratory, Upton, New York 11973). *Journal of the Optical Society of America B: Optical Physics;* **2**: No. 5, 786-789(May 1985). Contract AC02-76CH00016.

Twenty vibration-rotation lines in the bending fundamental of HN_2^+ have been detected by absorption spectroscopy using a tunable-diode laser. The ions were produced in a large hollow-cathode discharge in a mixture of hydrogen and nitrogen maintained at liquid-nitrogen temperature. Analysis of the spectrum provides an accurate determination of the ν_2 band origin and the major parameters describing the (01 ^{1}0) state of the ion.

32531 Orientation dependence of the H + D_2 reaction cross section: steric model vs. trajectory calculations. Blais, N.C.; Bernstein, R.B.; Levine, R.D. (Los Alamos National Lab., NM). *Journal of Physical Chemistry;* **89**: No. 1, 10-13(3 Jan 1985).

Quasiclassical trajectory calculations of the orientation dependence of the cross section for the $H + D_2 \rightarrow HD + D$ reaction have been carried out at collision energies of 0.55 and 1.30 eV. The results are well approximated by the angle-dependent barrier, line-of-centers steric model of Levine and Bernstein. 18 references, 3 figures, 1 table.

32532 Search for stationary points on surfaces. Banerjee, A.; Adams, N.; Simons, J.; Shepard, R. (Univ. of Utah, Salt Lake City). *Journal of Physical Chemistry;* **89**: No. 1, 52-57(3 Jan 1985). Contract W-31-109-ENG-38.

Algorithms for finding local minima, maxima, and saddle points on surfaces, starting from an arbitrary point are presented. These algorithms are based on making a local approximation to the surface in the form of a rational function constructed from the local first and second derivatives of the surface. All parameters of these algorithms required for stepping across the surface are determined in nonarbitrary ways. The convergence of these procedures to the desired stationary point is shown to be quadratic. Applications for stationary-point searches on two model surfaces are also given for illustrative purposes. 12 references, 4 figures.

32533 Spectroscopic constants for tritiated and deuterated H3(+). Carney, G.D. (Allegheny College, Meadville, PA). *Canadian Journal of Physics;* **62**: 1871-1874(Dec 1984).

Theoretical vibration-rotation coefficients for tritiated and deuterated H3(+) are reported for Carney and Porter's (1974) ab initio electronic Cl potential energy surface. In the calculation of coefficients connecting the zero-point and fundamental states of vibration, accurate vibrational Cl wave functions consisting of 220 configuration functions were used.

6404 Fluid Physics

REFER ALSO TO CITATION(S) 31826

32534 (AD-A—150145/1/XAB) Ion transport in beam-plasma interactions. Annual report, 30 September 1983-30 September 1984. Stern, R.A. (Colorado Univ., Boulder (USA)). 30 Sep 1984. 8p. NTIS, PC A02/MF A01.

This interm report covers work performed on the topic of laser-fluorescence measurements of ion beam scattering and transport of background ions during beam-plasma interactions. Achievements to date include (1) construction and operation of the plasma device, (2) assembly of a diagnostic pulsed laser, and (3) assembly and emplacement of the detection system. Future work plans, personnel changes and general scientific activities are described.

32535 (AD-A—151225/0/XAB) Plasma initiation/flow chamber to study cw-laser-beamed energy absorption in light gases. Annual report, 1 February 1983-30 January 1984. Krier, H.; Mazumder, J.; Glumb, R.J.; Bender, T.D.; Rockstroh, T.J. (Illinois Univ., Urbana (USA). Dept. of Mechanical and Industrial Engineering). 1 Mar 1984. 75p. (UILU-ENG—84-4002). NTIS, PC A04/MF A01.

This report summarizes the research work of the past year, investigating the use of laser-sustained plasmas for propulsion applications. One focus of the research is the initiation of plasmas in inert gases using metal-vapor seedants. Another is to define the operating characteristics of the dual-flow design by measuring temperatures, number densities, and global absorption. A pressure chamber was built to permit observations of the plasma under wide ranges of pressure, flow conditions, and beam geometry. Laser energy absorption will be measured using a high -flux calorimeter, and temperature profiles will be found using a combination of spectroscopic relative line-intensity measurements, thermocouples, infrared thermography, and possible laser-induced fluorescence. The report summarizes the design and construction of the pressure chamber, optics, and related equipment, and discusses the techniques that will be used to analyze temperatures throughout the flowfield.

32536 (AD-A—151502/2/XAB) Electric-discharge excitation and energy source integration. Final report, 30 January 1980-31 December 1983. Grosjean, D.F. (Systems Research Labs., Inc., Dayton, OH (USA). Research Applications Div.). 6 Jan 1985. 170p. (SRL—6569). NTIS, PC A08/MF A01.

Methods of transferring energy from electrical storage to an electro-negative gas discharge at high repetition rates of approx < 1.5 kHz are examined. The electrical-energy range of interest is 1 - 10 J. The XeC1 gas-discharge laser system is used as a representative discharge. Computer modeling of the pertinent kinetics of a He/Xe/HC1 gas mixture which was performed in conjunction with various configurations of pulse-forming networks is described; gas thyratrons and magnetic switches were used as switching elements. Due to the relatively constant E/N characterisitics of this system, a stripline arrangement is shown to provide the most efficient method of energy transfer for pulse lengths approx < 50 nsec. Capacitor discharge methods are applicable to shorter pulse lengths. Construction of a closed-cycled, high-rep-rate XeC1 gas-discharge laser is described. Operation of an x-ray preionized system at 1.5 kHz is also detailed; no contamination was observed in this configuration. The application of the XeC1 laser as a pump source for a high-rep-rate, high-average-power dye laser is also described. A flowing-dye jet was utilized in order to avoid liquid-cell boundary-layer problems of a fast-flow stream. The optical quality of the jet stream was the limiting factor in achieving the power goals. A method of achieving high efficiency in a rare-gas-halide system is proposed via a magnetic switch and prepulse arrangement in conjunctions with a stripline PFN. A high-efficiency pulse-charging source is also described.

32537 (IFT-P—06/83) Magnetic transition in the jellium model. Aguilera-Navarro, V.C.; Zimerman, A.H.; Llano, M. de. (Instituto de Fisica Teorica, Sao Paulo (Brazil)). 1983. 11p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700987.

Two-point Pade approximants are employed to interpolate between the known high - and low - density ground state energy expansions for the electron gas problem to predict the paramagnetic-tpo-ferromagnetic transition point in excellent agreement with recent computer simulations.

32538 (K/TS—11-516) Stability of Timoshenko beams conveying a compressible fluid. Johnson, R.O. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). Dec 1984. Contract AC05-84OT21400. 189p. NTIS, PC A09/MF A01; GPO Dep. File Number DE85013096.

Thesis. Submitted to the Univ. of Tennessee, Knoxville.

The purpose of this study is to formulate and solve the stability problem associated with the equations of motion of a Timoshenko beam conveying a compressible fluid. The beam is assumed to be either cantilevered or simply supported. Shear deformation and rotary inertia are considered in the Timoshenko beam theory. The beam analysis that is carried out is quite general and allows for viscous damping external to the tube as well as both internal strain rate and hysteretic damping. Interactions between these three damping mechanisms, shear deformation, and rotary inertia are also accounted for. The compressible, isentropic flow through the tube is governed by Euler's equations of motion. Gravitational effects are neglected in the analysis. This is equivalent to assuming that the tube is horizontal. The motion of the fluid is coupled to that of the beam by a compatibility condition at the tube wall which requires that they vibrate together. 132 refs., 39 figs., 13 tabs.

32539 **(LA-UR—85-1049) Gradient scaling for nonuniform meshes.** Margolin, L.G.; Ruppel, H.M.; Demuth, R.B. (Lawrence Livermore National Lab., CA (USA); Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 13p. (CONF-850745—7). NTIS, PC A02/MF A01; GPO Dep. File Number DE85009625.

From 4. international conference on numerical methods in laminar and turbulent flow; Swansea, UK (8 Jul 1985).

This paper is concerned with the effect of nonuniform meshes on the accuracy of finite-difference calculations of fluid flow. In particular, when a simple shock propagates through a nonuniform mesh, one may fail to model the jump conditions across the shock even when the equations are differenced in manifestly conservative fashion. We develop an approximate dispersion analysis of the numerical equations and identify the source of the mesh dependency with the form of the artificial viscosity. We then derive an algebraic correction to the numerical equations - a scaling factor for the pressure gradient - to essentially eliminate the mesh dependency. We present several calculations to illustrate our theory. We conclude with an alternate interpretation of our results. 14 refs., 5 figs.

32540 **(SAND—85-0111) Preliminary considerations for the gasdynamic precompression of solid molecular hydrogen.** Barker, L.M.; Trucano, T.G.; Asay, J.R.; Wise, J.L. (Sandia National Labs., Albuquerque, NM (USA)). Mar 1985. Contract AC04-76DP00789. 74p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85013256.

In this report, we present a preliminary examination of the feasibility of quasi-isentropically compressing solid or liquid molecular hydrogen to multi-megabar pressures by means of a gas-cushioned projectile impact experiment. The primary purpose for using a gas-cushioned projectile is to prevent large temperature increases in the sample. We present initial experimental design concepts, and a series of one-dimensional Lagrangian computations that demonstrate the feasibility of the experimental concepts. We briefly discuss the expected temperature rises in the hydrogen sample undergoing continuous compression, and contrast them with the temperature rises expected in direct shock loading. This experimental procedure will allow the acquisition of very high pressure data which are beyond the range of diamond-anvil cell technology. Since the estimated peak pressures of the experiment are within theoretical predictions of the metal-insulator transition in molecular hydrogen, the proposed experiment will directly probe the existence of this transition. The molecular-to-metallic transition in hydrogen is a subject of current importance in solid-state physics. 34 refs., 29 figs., 2 tabs.

32541 **(UNICP-J—83) Progress report 1 October 1980-30 September 1983 of the section 'Plasma Physics' of the 'Institute for Theoretical Physics' at the Leopold Franzens University, Innsbruck, Austria.** Cap, F. (Innsbruck Univ. (Austria)). Jan 1984. 20p. (In German). NTIS (US Sales Only), PC A02/MF A01. File Number DE85701536.

Publications and lectures by members of the institute, visiting scientists and current projects are listed.

32542 **Normalization constraint for variational bounds on fluid permeability.** Berryman, J.G.; Milton, G.W. (Lawrence Livermore National Laboratory, P. O. Box 808, L-201, Livermore, California 94550). *Journal of Chemical Physics;* **83**: No. 2, 754-760(15 Jul 1985).

A careful reexamination of the formulation of Prager's original variational principle for viscous flow through porous media has uncovered a subtle error in the normalization constraint on the trial functions. Although a certain surface integral of the true pressure field over the internal surface area always vanishes for isotropic materials, the corresponding surface integral for a given trial pressure field does not necessarily vanish but has nevertheless been previously neglected in the normalization. When this error is corrected, the form of the variational estimate is actually simpler than before and furthermore the resulting bounds have been shown to improve when the constant trial functions are used in either the two-point or three-point bounds.

32543 **Numerical solution of the Graetz problem for a bingham plastic in laminar tube flow with constant wall temperature.** Blackwell, B.F. (Centrifuge, Climatic and Radiant Heat, Division 7531, Sandia National Laboratories, Albuquerque, N. M. 87185). *Journal of Heat Transfer;* **107**: No. 2, 466-471(May 1985). Contract AC04-76DP00789.

The Sturm-Liouville equation is used to study:m the heat transfer properties of aqueous foams used as a drilling fluid. (AIP)

32544 **Velocity and vorticity correlations.** Berger, B.S. (University of Maryland). *Quarterly of Applied Mathematics;* **43**: No. 1, 97-126(Apr 1985). Contract AS05-81ER10809.

It is shown that one point velocity correlations may be expressed as a volume integral of the product of the singular part of Green's function and a function, h/sub j/m(x,X), which satisfies Poisson's equation and vanishes for points on the boundary. An explicit expression is found for h/sub j/m(x,X). These results provide a computational method for determining the velocity correlations.

32545 **Numerical study of gravity currents in a channel.** Wang, D. (Energy and Environmental Systems Division, Argonne National Laboratory, Argonne, IL 60439). *Journal of Physical Oceanography;* **15**: No. 3, 299-305(Mar 1985).

A three-dimensional, primitive-equation model was used to study gravity currents produced by instantaneous releases of a buoyant fluid in a rectangular channel. Without rotation, the gravity current passes through two distinct phases: an initial adjustment phase in which the front speed is constant, and an eventual self-similar phase in which the front speed decreases with time. With rotation, the gravity current is confined to the right-hand wall, forming a coastal jet. The initial front-speed is constant; however, the front speed decreases rapidly due to strong mixing at the horizontal edge of the gravity current. Also, with rotation, part of the buoyant fluid is trapped near the source region, forming an anticyclonic vortex.

32546 **Second-order theory of electromagnetic hot ion beam instabilities.** Gary, S.P.; Tokar, R.L. (Earth and Space Sciences Division, Los Alamos National Laboratory, New Mexico). *Journal of Geophysical Research;* **90**: No. A1, 65-72(1 Jan 1985).

The wave-particle interactions of a hot ion beam streaming along a magnetic field B are studied. A second-order theory of electromagnetic instabilities in a homogeneous, collisionless plasma at propagation parallel to B is used. The two instabilities most likely to be driven by a hot beam are the right-hand and left-hand resonant ion beam instabilities. If the conditions necessary for the validity of the theory are met, the two modes are found to reinforce one another. That is, each mode acts to produce a beam anisotropy which reduces its own growth rate but enhances the growth rate of the other. Thus this theory predicts that whenever sufficiently hot or "diffuse" ions are found at a collisionless shock and the plasma is sufficiently homogeneous that significant wave growth is possible, ion beam instabilities will act to produce a mixture of both right- and left-hand polarized MHD-like waves.

32547 **Plasma heating at collisionless shocks due to the kinetic cross-field streaming instability.** Winske, D.; Tanaka, M.; Wu, C.S.; Quest, K.B. (Institute for Fusion Studies, Hiroshima University, Japan). *Journal of Geophysical Research;* **90**: No. A1, 123-136(1 Jan 1985).

Heating at collisionless shocks due to the kinetic cross-field streaming instability, which is the finite beta (ratio of plasma to magnetic pressure) extension of the modified two stream instability, is studied. Heating rates are derived from quasi-linear theory and compared with results from particle simulations to show that electron heating relative to ion heating and heating parallel to the magnetic field relative to perpendicular heating for both the electrons and ions increase with beta. The simulations suggest that electron dynamics determine the saturation level of the instability, which is manifested by the formation of a flattop electron distribution parallel to the magnetic field. As a result, both the saturation levels of the fluctuations and the heating rates decrease sharply with beta. Applications of these results to plasma heating in simulations of shocks and the earth's bow shock are described.

32548 **Ion and electron heating at collisionless shocks near the critical Mach number.** Thomsen, M.F.; Gosling, J.T.; Bame, S.J.; Mellott, M.M. (Los Alamos National Laboratory, New Mexico). *Journal of Geophysical Research;* **90**: No. A1, 137-148(1 Jan 1985).

The evolution of the ion and electron distribution functions across a set of 10 low-Mach number, nominally subcritical, quasi-perpendicular shocks is examined in high time resolution (full distribution every 3 s) using data from the ISEE 1 and 2 spacecraft. Both ions and electrons sometimes show slight preheating upstream of the shock, but otherwise the ion and electron temperatures rise together in the magnetic ramp and show no further increase downstream. Contrary to the usual assumption based on early laboratory and theoretical work that at subcritical shocks the bulk of the energy dissipation occurs as resistive heating of the electrons, it is found that the ion temperature increase exceeds that of the electrons. The difference is attributed to the distinction between dispersive shocks, such as those studied here, and resistive shocks, such as those observed in most laboratory studies. The increase in ion temperature is predominantly in the perpendicular direction and is due to heating of the entire distribution rather than to the formation of a high-energy tail. The perpendicular temperature increase is typically a factor of 10—20, much greater than the usual assumption of adiabatic heating. The downstream to upstream ratio of perpendicular electron temperature is equal to the magnetic field ratio (~2—2.5). The electrons also show significant heating in the parallel direction, with the downstream T/sub parallel//T/sub perpendicular/ ~1—1.2. The downstream electron distribution exhibits the characteristic flattop seen downstream of supercritical shocks, and there is evidence for the field-aligned electron beam identified previously within those shocks. As previously reported, the downstream ion and electron total temperatures are nearly equal.

32549 **Essential spectrum of ideal magnetohydrodynamics.** Hameiri, E. (New York Univ., NY). *Communications on Pure and Applied Mathematics;* **38**: 43-66(Jan 1985). Contract AC02-76ER03077.

The essential spectrum of magnetohydrodynamics is shown to arise from waves propagating one-dimensionally along magnetic field lines. Different polarizations of these waves give rise to the Alfven and ballooning spectra. The essential spectrum of an axisymmetric equilibrium when a single azimuthal mode number is considered consists of the Alfven spectrum only, while the ballooning modes appear as intervals of accumulation of discrete eigenvalues with different mode numbers. Some necessary and one sufficient conditions for stability are derived, and some examples where the criteria coincide to yield a simple condition for stability are shown. 29 references.

6450 High Energy Physics

REFER ALSO TO CITATION(S) 32663, 32751

32550 **Review-of-Particle-Properties system.** Trippe, T.G. (Lawrence Berkeley Lab., CA (USA). Particle Data Group). *Computer Physics Communications;* **33**: No. 1-3, 229-233(Aug-Sep 1984). (CONF-8306255—).

From 5. summer school on computing technics in physics: data bases and data structures in physics; Bechyne, Czechoslovakia (21 Jun 1983).

The Berkeley Particle Data Group is engaged in a major modernization of its primary project, the Review of Particle Properties, a compilation of experimental data on elementary particles. The goal of this modernization is to develop an integrated system for data storage, manipulation, interactive access and publication using modern technqiues for database management, text processing and phototypesetting. The existing system and the plans for modernization are described. The group's other projects and the computer systems used are also discussed.

6451 Particle Interactions And Properties - Experimental

REFER ALSO TO CITATION(S) 32021, 32576, 32621, 32667, 32673

32551 **(BONN-HE—84-36) Experimental results on hadron pair production by two photons.** Kueck, H. (Bonn Univ. (Germany, F.R.). Physikalisches Inst.). Nov 1984. 31p. (CONF-8409194—4). NTIS (US Sales Only), PC A03/MF A01. File Number DE85751625.

From 6. international workshop on photon-photon collisions; Lake Tahoe, CA, USA (9 Sep 1984).

This report reviews the experimental results on non-resonant exclusive production of hadron pairs in photon-photon collisions. The cross section for charged pion pairs in the invariant mass range below the f resonance is discussed. The measured cross sections show no evidence for scalar resonances. At momentum transfer vertical stroketvertical stroke > 1.6 GeV^2 the sum of the cross sections for charged pion and kaon pairs are found to be in remarkable agreement with a theoretical model based on perturbative QCD. Cross sections for proton-antiproton production and upper limits on Λanti Λ, Δanti Δ production are discussed.

32552 **(CERN-EP—82-99) Hadronic final states in deep inelastic muon interactions.** Dosselli, U. (European Organization for Nuclear Research, Geneva (Switzerland)). 15 Jul 1982. 33p. (CONF-8205304—1). NTIS (US Sales Only), PC A03/MF A01. File Number DE85901016.

From 5. Warsaw symposium on elementary particle physics; Kazimierz, Poland (1 May 1982).

New data on the hadronic final states produced in deep inelastic interactions of muons are presented and compared with theoretical models. Some preliminary results on hadron production from scattering on nuclear targets are also reported.

32553 **(CERN-EP—84-125) Message from light ions: an experimental review of the search for abnormal phenomena in high-energy nucleus-nucleus collisions.** Szwed, R. (Warsaw Univ. (Poland). Inst. Fizyki Doswiadczalnej). 17 Sep 1984. 32p. (CONF-8406189—10). NTIS (US Sales Only), PC A03/MF A01. File Number DE85900486.

From 4. international conference on ultrarelativistic nucleus-nucleus collisions - QUARK MATTER '84; Helsinki, Finland (17 Jun 1984).

The experimental data from the CERN intersecting Storage Rings (ISR) and from Dubna and Berkeley on the search for abnormal nuclear phenomena in high-energy nucleus-nucleus collisions is reviewed. 48 refs.

32554 **(DESY—84-043) Production and decay of the F-meson in e^+e^- annihilation at 10 GeV centre-of-mass energy.** Albrecht, H.; Binder, U.; Drews, G.; Harder, G.; Hasemann, H.; Philipp, A.; Schmidt-Parzefall, W.; Schroeder, H.; Schulz, H.D.; Selonke, F. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Dec 1984. 16p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85751629.

Using the ARGUS detector at DORIS, we have observed the production of Fsup(+-) mesons in e^+e^- annihilation at a centre of mass energy of 10 GeV through their subsequent decays into PHIπsup(+-) and PHI$\pi^+\pi^-\pi$sup(+-). The values obtained for [R(e^+e^- -> F x). Branching Ratio] are (1.47 +- 0.32 +- 0.20)% and (1.63 +- 0.42 +- 0.41)% respectively. The observed mass is (1973.6 +- 2.6 +- 3.0) MeV/c^2. The F momentum spectrum is as expected for the fragmentation of c quarks into charmed mesons, but is somewhat softer than for fragmentation into Dsup(*) mesons. The relevant angular distributions are consistent with a spin zero assignment of the F meson.

32555 **(DESY—84-104) Heavy quark fragmentation.** Izen, J.M. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Oct 1984. Contract AC02-76ER00881. 36p. (CONF-8406183—10; WISC-ex—84-244). NTIS (US Sales Only), PC A03/MF A01. File Number DE85750987.

From 15. international symposium on multiparticle dynamics; Lund, Sweden (11 Jun 1984).

Recent developments in the field of charm and bottom quark fragmentation are reviewed. Results derived from direct charm meson reconstruction and from inclusive lepton analyses are shown. Two experimentally related topics, semileptonic branching ratios and the weak asymmetry of heavy quarks are also discussed.

32556 (DESY—84-121) Tests of the standard model with lepton pair production in e^+e^- reactions. Berger, C.; Deuter, A.; Genzel, H.; Lackas, W.; Pielorz, J.; Raupach, F.; Wagner, W.; Klovning, A.; Lillestoel, E.; Bussey, P.J. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Dec 1984. 24p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85751628.

The differential cross section of the reaction e^+e^- -> e^+e^- at a c.m. energy of 34.7 GeV has been measured. The result, together with our previously measured e^+e^- -> $\mu^+\mu^-$ data, are compared with the standard model predictions. We obtain for the weak neutral current couplings the values gsub(v)^2=0.09 +- 0.06, gsub(a)^2=0.38 +- 0.08. A fit of the Weinberg mixing angle gives the value sin^{2}deltasub(w)=0.13 sup(+0.03)sub(-0.02)(1 sigma) sup(+0.08)sub(-0.03)(2 sigma). The data are also used to set limits on possible deviations from the pointlike structure of leptons. An upper limit for the e^+e^- coupling to a heavy spin 0 boson is also given.

32557 (DESY—85-001) Search for spinless bosons in e^+e^- annihilation. Althoff, M.; Braunschweig, W.; Kirschfink, F.J.; Martyn, H.U.; Rosskamp, R.; Schmitz, D.; Siebke, H.; Wallraff, W.; Eisenmann, J.; Fischer, H.M. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Jan 1985. 16p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85751634.

We have measured the cross sections for e^+e^- -> e^+e^-, e^+e^- -> $\mu^+\mu^-$, e^+e^- -> $\gamma\gamma$ and e^+e^- -> hadrons in an energy scan at center of mass energies between 39.79 and 46.72 GeV in 30 MeV steps. New spinless bosons, whose existence has been postulated as a possible means to explain the anomalously large radiative width of the Z^0 found at the CERN SPS panti p collider, are ruled out in the scan region. The data are used to set limits on the couplings to lepton, photon and quark pairs of bosons with masses above 46.72 GeV.

32558 (DOE/ER/01195—498) Production of omega and phi mesons by 193 GeV/C pions and 250 GeV/C protons on a beryllium target. Bellinger, J.N. (Illinois Univ., Urbana (USA). Dept. of Physics). 1985. Contract AC02-76ER01195. 158p. (COO—1195-498). NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE85011217.

Omegas and phis were observed in di-muon events. Differential cross sections with respect to perpendicular momentum and Feynman-X for both meson types and both beam types are compared. When a simple parton fusion model is used to describe the Feynman-X distributions the omega appears to be produced predominantly by gluon fusion. 73 refs.

32559 (DOE/ER/40105—T2) Radiative decay of the K^{*-}(890). Berg, D.; Chandlee, C.; Cihangir, S.; Ferbel, T.; Huston, J.; Jensen, T.; Lobkowicz, F.; Nelson, C.A. Jr.; Ohshima, T.; Slattery, P. (Rochester Univ., NY (USA). Dept. of Physics and Astronomy; Fermi National Accelerator Lab., Batavia, IL (USA); Minnesota Univ., Minneapolis (USA)). [1985]. Contract AC02-83ER40105. 11p. (COO—1764-390). NTIS, PC A02/MF A01; GPO Dep. File Number DE85011547.

We report a measurement of the radiative decay of the K^{*-}(890). The width for the transition $K^{*-} \rightarrow K^-\gamma$ is 62 $^{+-}$ 14 keV. The resulting ratio of decay probabilities ($K^{*0} \rightarrow K^0\gamma$)/($K^{*-} \rightarrow K^-\gamma$), while consistent with predictions of certain quark models, does not agree with expectations from unbroken SU(3) symmetry. 9 refs.

32560 (IFVE-OEF—83-203) Investigation of D(1285) and E(1420) meson production in exclusive interactions of negatively charged pions and kaons at the momentum 32,5 GeV/c. Bityukov, S.I.; Viktorov, V.A.; Golovkin, S.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1983. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85701011.

Submitted to the journal Nucl. Phys.

Mixing angle in the axial meson nonet 6 delta 6 < 13 deg (delta=0 corresponds to the ideal mixing), so e(1420) consists of strange quarks mainly. a signal from the e(1420) meson has been observed in the reaction [k]p → k[k] πy. a large value for the ratio σ[k]p → e(1420)y]/σ[π]p → e(1420y] that is greater than 10, confirms the conclusion on the e meson quark contents.

32561 (IFVE-OEIPK—83-108) Neutral strange particle production in K^+p interactions at 32 GeV/c. Azhinenko, I.V.; Vorob'ev, A.P.; Garuchava, Z.S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1983. 59p. (In Russian). NTIS (US Sales Only), PC A04/MF A01. File Number DE85701012.

Submitted to the journal Sov. J. Nucl. Phys. .

The production properties of Ksub(s)sup(0), antiΛ and Λ production in K^+p interactions at 32 GeV/c are investigated using the final statistics of 10^6 events. Data on total and semi-inclusive cross sections and average multiplicities are presented. Estimates are given of the diffractive dissociation contributions to Ksub(s)suop(0), antiΛ and Λ total and differential cross sections. The x, Psub(T), x is Feynman variable, Psub(T) is transverse momentum and transverse mass dependence of inclusive and semi-inclusive distributions is discUssed as well as properties of "prompt" Ksub(s)sup(0) s. The ratio of K_{890}^{*+} (K_{890}^{*0}) to prompt K^0 cross sections is measured to be 1.03+-0.12 (0.98+-0.17). From a comparison of antiΛ cross sections in $K^{+-}p$ collisions at 32 GeV/c, the strange sea (anti ss) production probability is established, relative to (anti uu) or (anti dd) creation to be 0.26+-0.02. The double differential cross section of Ksub(s)sup(0) is studied as a function of x and Psub(T)sup(2) and a triple-Regge fit performed. Main results of the checked detailed analysis of the Ksub(s)sup(0), antiΛ and Λ prodUction processes in the K^+p-interactions at 32 GeV/c may be formulated as follows: the Ksub(s)sup(0) and Λ total inclusive cross sections in the primary momentum range of 16 to 147 GeV/c and those of antiΛ at 16 to 70 GeV/c increase with energy according to a logarithmic law. Average multiplicities of Ksub(s)sup(0), antiΛ and Λ in the events with fixed multiplicities of n charged particles linearly decrease with the n growth. The Ksub(s)sup(0), antiΛ and Λ production cross sections in diffraction processes are small compared with the total inclusive cross sections and make up σ(Ksub(D)sup(+) → Ksub(s)sup(0)X)=180+-30 μb, σ(Ksup(D)sup(+) → antiΛX)=12+-6 μb and σ(Psub(D) → ΛX)=9+-4 μb. Most of the results are compared in detail to the Lund model for low-Psub(T) hadron-hadron collisions.

32562 (INIS-mf—9299, pp 63) Direct lepton production in high energy hadron interactions. Specht, H.J. (Heidelberg Univ. (Germany, F.R.). Physikalisches Inst.). 1984. NTIS (US Sales Only), PC A10/MF A01. File Number DE85780947. (CONF-840166—).

From 12. international workshop on gross properties of nuclei and nuclear excitations; Hirschegg, Austria (16 Jan 1984).

Published in summary form only.

32563 (INIS-mf—9299, pp 121-123) Deep inelastic scattering of charged leptons and quark distributions in nuclei. Rith, K. (Freiburg Univ. (Germany, F.R.). Fakultaet fuer Physik). 1984. NTIS (US Sales Only), PC A10/MF A01. File Number DE85780947. (CONF-840166—).

From 12. international workshop on gross properties of nuclei and nuclear excitations; Hirschegg, Austria (16 Jan 1984).

One class of experiments is a detailed investigation of the A and Q^2 dependence of the effect by studying F_2sup(N) for a variety of nuclei. A scan of the A dependence has already been performed at SLAC, where the cross section per nucleon for D, He, Be, C, Al, Ca, Fe, Ag, and Au were measured in the kinematic range

$0.09<=x<=0.9$ and $2<=Q^2<=15$ $(GeV/c)^2$, using electrons with energies ranging from 8 to 24.5 GeV. (orig./HSI).

32564 (JINR—R-6-84-149) Measurement of the neutrino helicity in the decay of sup(152m)Eu with Ge(II) detector. Vylov, Ts.; Brudanin, V.B.; Gorozhankin, V.M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1984. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85701010.

The new experiment on the determination of the neutrino helicity from the decay of sup(152 m)Eu by the measurement of the 963.4 keV gamma-ray circular polarization (Hsub(γ)) was performed. The theoretical estimate of Hsub(γ) taking into accout not only the intrinsic level width and K-capture but also the thermal motion and the capture in a hiqher shells is - 0.93, which obiously disagrees with the results of previous experiments. The new measurement of Hsub(γ) with a 100 cm^3 Ge(Li) detector has given the value-0.87+-0.10, which is in good agreement with both the abovementioned estimate and the assumption of the neutrino helicity to be Hsub(ν)=-1.

32565 (SLAC-PUB—3683) Status of the zeta(8.3). Lowe, S.T. (Stanford Linear Accelerator Center, CA (USA)). May 1985. Contract AC03-76SF00515. 5p. (CONF-850375—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE85013070.

From 20. Rencontre de Moriond; Les Arcs, France (10 Mar 1985).

Results are presented from 22.1 pb^{-1} of Y(1S) data, taken with the Crystal Ball detector at DORIS. These data were taken to further explore the zeta(8.3) signal originally seen in 10.4 pb^{-1} of Y(1S) data. No evidence for the zeta is observed in this new sample. Data quality checks and possible explanations are discussed.

32566 (UR—824) Radiative width of the K^{*+}(1430) and radiative width of the A_2(1310). Cihangir, S.; Berg, D.; Biel, J.; Chandlee, C.; Collick, B.; Droege, T.; Ferbel, T.; Heppelmann, S.; Huston, J.; Jensen, T. (Rochester Univ., NY (USA). Dept. of Physics and Astronomy). 1981. Contract AC02-83ER40105. 21p. (COO—3065-332; COO—1764-441). NTIS, PC A02/MF A01; GPO Dep. File Number DE85012394.

Using the Primakoff formalism, we have extracted the radiative decay width of the K^{*+}(1430) produced in coherent interactions of 200 GeV/c K^+ mesons in nuclear targets and the radiative decay width of the A_2^+(1310) produced in coherent interactions of 200 GeV/c π^+ mesons in nuclear targets. The widths obtained are 240 +- 45 keV and 295 +- 60 keV, respectively, values reasonably consistent with quark-model predictions.

32567 Charged-hyperon production by 400-GeV protons. Cardello, T.R.; Cooper, P.S.; Teig, L.J.; Thron, J.L.; Wah, Y.; Ankenbrandt, C.; Berge, J.P.; Brenner, A.E.; Butler, J.; Doroba, K. (Yale University, New Haven, Connecticut 06520). *Physical Review* [*Section*] *D: Particles and Fields;* **32**: No. 1, 1-10(1 Jul 1985).

Differential production cross sections have been measured for Σ^-, Ξ^-, Ω^-, Σ^+, Sigma-bar$^+$, and Xi-bar$^+$ relative to pion production at several x/sub F/ and P/sub T/ with 0.24<eqx/sub F/<eq0.90 and P/sub T/<eq2 GeV using 400-GeV protons incident on a Cu target. The data can be described by the function A(1-x/sub F/)/sup n/eT, where A and n depend only on the hyperon type, and B is quadratic in x/sub F/, and also depends on hyperon type. Comparison with previous experiments supports scaling in x/sub F/ over the range 200—400 GeV/c.

32568 Measurement of the electron asymmetry in the beta decay of polarized Σp hyperons. Hsueh, S.Y.; Muller, D.; Tang, J.; Winston, R.; Zapalac, G.; Swallow, E.C.; Berge, J.P.; Brenner, A.E.; Grafstrom, P.; Jastrzembski, E. (Enrico Fermi Institute, University of Chicago, Chicago, Illinois 60637). *Physical Review Letters;* **54**: No. 22, 2399-2402(3 Jun 1985). Contract AC02-80ER10587;AC02-76ER03075;AC02-76CH03000.

We report the results of a Fermilab Tevatron experiment using a Σ^- beam with a measured polarization of 0.22 +- 0.04. We find the electron asymmetry in Σ^- beta decay to be α/sub e/ = -0.53 +- 0.14 on the basis of a sample of 25 000 events, in agreement with the Cabibbo model and in contradiction with previous experiments. The corresponding value for the ratio of axial vector to vector form factors is g_1/f_1 = -0.29 +- 0.07. .AE

32569 Measurement of K(and K^0 inclusive rates in e^+e^- annihilation at 29 GeV. Schellman, H.; Trilling, G.H.; Abrams, G.S.; Amidei, D.; Baden, A.R.; Boyer, J.; Butler, F.; Dillon, J.B.; Gidal, G.; Gold, M.S.; Goldhaber, G.; Golding, L.J.; Haggerty, J.; Herrup, D.; Juricic, I.; Kadyk, J.A.; Nelson, M.E.; Rowson, P.C.; Schmidke, W.B.; Sheldon, P.D.; de la Vaissiere, C.; Wood, D.R.; Barklow, T.; Boyarski, A.M.; Breidenbach, M.; Burchat, P.R.; Burke, D.L.; Dorfan, J.M.; Feldman, G.J.; Gladney, L.; Hanson, G.; Hayes, K.; Himel, T.; Hollebeek, R.J.; Innes, W.R.; Jaros, J.A.; Karlen, D.; Lankford, A.J.; Larsen, R.R.; LeClaire, B.W.; Lockyer, N.S.; Lueth, V.; Matteuzzi, C.; Ong, R.A.; Perl, M.L.; Richter, B.; Riles, K.; Ross, M.C.; Schlatter, D.; Yelton, J.M.; Zaiser, C.; Levi, M.E.; Schaad, T. (Lawrence Berkeley Laboratory and Department of Physics, University of California, Berkeley, California 94720). *Physical Review* [*Section*] *D: Particles and Fields;* **31**: No. 11, 3013-3016(1 Jun 1985).

We have measured the K^0+K ^{0} inclusive cross section in e^+e^- annihilation at 29 GeV with the Mark II detector SLAC PEP. We find 1.27 +- 0.03 +- 0.15 K^0+K ^{0} per hadronic event. We have also used time-of-flight particle identification to measure the K^{+-} rate over the momentum range 300—900 MeV/c.

32570 Prompt muon production in e^+e^- annihilations at 29 GeV. Aihara, H.; Alston-Garnjost, M.; Badtke, D.H.; Bakken, J.A.; Barbaro-Galtieri, A.; Barnes, A.V.; Barnett, B.A.; Bengtsson, H.; Blumenfeld, B.J.; Bross, A.D. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720 University of California, Los Angeles, California 90024 University of California, Riverside, California 92521 Johns Hopkins University,). *Physical Review* [*Section*] *D: Particles and Fields;* **31**: No. 11, 2719-2723(1 Jun 1985).

We have studied the production of prompt muons in hadronic events from e^+e^- annihilation at a center-of-mass energy of 29 GeV with the PEP4-TPC (Time Projection Chamber) detector. The muon p and p/sub t/ distributions are well described by a combination of bottom- and charm-quark decays, with fitted semimuonic branching fractions of (15.2 +- 1.9 +- 1.2)% and (6.9 +- 1.1 +- 1.1)%, respectively. The muon spectra imply hard fragmentation functions for both b and c quarks, with <z(b quark)> = 0.80 +- 0.05 +- 0.05 and <z(c quark)> = 0.60 +- 0.06 +- 0.04. We derive neutral-current axial-vector couplings of a(b quark) = -0.9 +- 1.1 +- 0.3 and a(c quark) = 1.5 +- 1.5 +- 0.5 from the forward-backward asymmetries.

32571 Measurement of energy-energy correlations in $e^+e^-\rightarrow$hadrons at $\sqrt{s}$ = 29 GeV. Fernandez, E.; Ford, W.T.; Qi, N.; Read A.L. Jr.; Smith, J.G.; Camporesi, T.; De Sangro, R.; Marini, A.; Peruzzi, I.; Piccolo, M.; Ronga, F.; Blume, H.T.; Hurst, R.B.; Sleeman, J.C.; Venuti, J.P.; Wald, H.B.; Weinstein, R.; Band, H.R.; Gettner, M.W.; Goderre, G.P.; Meyer, O.A.; Moromisato, J.H.; Shambroom, W.D.; von Goeler, E.; Ash, W.W.; Chadwick, G.B.; Clearwater, S.H.; Coombes, R.W.; Kaye, H.S.; Lau, K.H.; Leedy, R.E.; Lynch, H.L.; Messner, R.L.; Moss, L.J.; Muller, F.; Nelson, H.N.; Ritson, D.M.; Rosenberg, L.J.; Wiser, D.E.; Zdarko, R.W.; Groom, D.E.; Lee, H.; Delfino, M.C.; Heltsley, B.K.; Johnson, J.R.; Lavine, T.L.; Maruyama, T.; Prepost, R. (Department of Physics, University of Colorado, Boulder, Colorado 80309). *Physical Review* [*Section*] *D: Particles and Fields;* **31**: No. 11, 2724-2731(1 Jun 1985).

The energy-energy correlation cross section for hadrons produced in electron-positron annihilation at a center-of-mass energy of 29 GeV has been measured with the MAC detector at SLAC. The result is corrected for the effects of detector resolution, acceptance, and initial-state radiation. The correlation is measured in two independent ways on the same data sample: the energy weights and angles are obtained either from the energy flow in the finely segmented total absorption calorimeters or from the momenta of charged tracks in the central drift chamber. This procedure helps reduce systematic errors by cross-checking the effects of the detector on the measurement, particularly important because the corrections depend on complex Monte Carlo simulations. The results are compared with the predictions of Monte Carlo models of complete second-order perturbative quantum chromodynamics and fragmentation, with the following conclusions: (1) fitting the asymmetry for large correlation angles gives values for α/sub S/ of 0.120 +- 0.006 in perturbation theory, 0.185 +- 0.013 in the Lund string model, and values which vary from 0.105 to 0.140 (+- 0.01) in the incoherent jet models, depending on the gluon fragmentation scheme and the algorithm used for momentum conservation; and (2) the string fragmentation model provides a satisfactory description of the measured energy-energy correlation cross section, whereas incoherent jet formation does not.

32572 New limit on the strength of mixing between ν/sub μ/ and ν/sub e/. Ahrens, L.A.; Aronson, S.H.; Connolly, P.L.; Gibbard, B.G.; Murtagh, M.J.; Murtagh, S.; Terada, S.; White, D.H.; Callas, J.L.; Cutts, D.; Hoftun, J.S.; Lanou, R.E.; Shinkawa, T.; Amako, K.; Kabe, S.; Nagashima, Y.; Suzuki, Y.; Tatsumi, S.; Abe, K.; Beier, E.W.; Doughty, D.C.; Durkin, L.S.; Heagy, S.M.; Hurley, M.; Mann, A.K.; Newcomer, F.M.; Williams, H.H.; York, T.; Hedin, D.; Marx, M.D.; Stern, E. (Physics Department, Brookhaven National Laboratory, Upton, New York 11973). *Physical Review [Section] D: Particles and Fields;* **31**: No. 11, 2732-2736(1 Jun 1985).

Measurements have been made of the reactions ν/sub e/ $n \rightarrow e^- p$ and ν/sub μ/$n \rightarrow \mu^- p$ in a detector located an effective distance of 96 m from a neutrino source. These measurements yield directly the energy-dependent ratio of the neutrino fluxes [Phi(E(ν/sub e/))/Phi(E(ν/sub μ/))]/sub obs/ incident on the detector. When combined with an estimate of the flux ratio emanating from the source [Phi(E(ν/sub e/))/Phi(E(ν/sub μ/))]/sub calc/, the measured ratio provides an upper limit on the strength of mixing between ν/sub μ/ and ν/sub e/. We obtain $\sin^2 2\alpha < 3.4 \times 10^{-3}$ (90% C.L.) in the limit of large mass difference Δm^2 (equivalent'$m_1{}^2$-$m_2{}^2$') between neutrino mass eigenstates, m_1 and m_2; and an upper limit on the product $\Delta m^2 \sin 2\alpha < 0.43$ eV^2 in the limit of small mass difference.

32573 Experimental consequences of family unification. Bagger, J.; Dimopoulos, S.; Masso, E.; Reno, M.H. (Lyman Laboratory of Physics, Harvard University, Cambridge, Massachusetts 02138 and Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). *Physical Review Letters;* **54**: No. 20, 2199-2202(20 May 1985). Contract AC03-76SF00515.

Theories of family unification predict four left-handed and four right-handed families of quarks and leptons, all with masses below 265 GeV. The lightest mirror quark has a mass of less than 140 GeV. All charged leptons are lighter than 55 GeV, and the lightest is below 40 GeV. All five new neutrinos have masses less than 40 GeV and contribute to the width of the Z^0. We study the decays of these new families, and discuss rare processes such as $\mu \rightarrow e\gamma$. We also examine proton decay, and show that it can proceed into $e^+ \pi^0$ at the observable but acceptable rate of 10/sup 32plus-or-minus1/ yr.

32574 Electroweak effects in $e^+ e^- \rightarrow$tau$^+$ tau$^-$ at 29 GeV. Fernandez, E.; Ford, W.T.; Qi, N.; Read A.L. Jr.; Smith, J.G.; Camporesi, T.; De Sangro, R.; Marini, A.; Peruzzi, I.; Piccolo, M.; Ronga, F.; Blume, H.T.; Hurst, R.B.; Venuti, J.P.; Wald, H.B.; Weinstein, R.; Band, H.R.; Gettner, M.W.; Goderre, G.P.; Meyer, O.A.; Moromisato, J.H.; Shambroom, W.D.; Sleeman, J.C.; von Goeler, E.; Ash, W.W.; Chadwick, G.B.; Clearwater, S.H.; Coombes, R.W.; Kaye, H.S.; Lau, K.H.; Leedy, R.E.; Lynch, H.L.; Messner, R.L.; Moss, L.J.; Muller, F.; Nelson, H.N.; Ritson, D.M.; Rosenberg, L.J.; Wiser, D.E.; Zdarko, R.W.; Groom, D.E.; Lee, H.; Delfino, M.C.; Heltsley, B.K.; Johnson, J.R.; Lavine, T.L.; Maruyama, T.; Prepost, R. (University of Colorado, Boulder, Colorado 80309). *Physical Review Letters;* **54**: No. 15, 1620-1623(15 Apr 1985). Contract AC02-81ER40025;AC03-76SF00515;AC02-76ER00881.

A high-statistics measurement is presented of the cross section for the process $e^+ e^- \rightarrow$tau$^+$ tau$^-$ at $\sqrt{s} = 29$ GeV from the MAC detector at PEP. A fit to the angular distribution of our sample of 10 153 events with '$\cos\theta$'<0.9 gives an asymmetry A/sub tautau/ = -0.055 +- 0.012 +- 0.005 from which we find the product of electron and tau axial-vector weak neutral couplings g/sub A//sup e/G/sub A//sup tau/ = 0.22 +- 0.05.

32575 Recent results in upsilon spectroscopy from CESR. Schamberger, R.D. Jr. (State Univ. of New York, Stony Brook). *AIP (American Institute of Physics) Conference Proceedings;* No. 98, 381-401(1983). (CONF-8210113—).

From American Physical Society meeting on particles and fields; College Park, MD, USA (28 Oct 1982).

In this report, results in upsilon spectroscopy from CESR are given. Primary emphasis in the past year in the area of spectroscopy has centered on the decay modes of the upsilon' (3^3S). Hadronic transitions to both lower laying S states have been measured. Photon transitions to the 2^3P states have been observed in both inclusive and exclusive channels. Branching ratios and parameters of the 2^3P states will be presented. Limits on other states in the upsilon system, accessible thru $e^+ e^-$ annihilations, and results on an axion search are also reported.

6452 Particle Interactions And Properties - Theoretical

REFER ALSO TO CITATION(S) 32573, 32626, 32639, 32642, 32644, 32645, 32656, 32659, 32760, 32762

32576 (BONN-HE—84-35) Survey of two-photon physics: What have we done, where are we going. Kolanoski, H. (Bonn Univ. (Germany, F.R.). Physikalisches Inst.). Nov 1984. 26p. (CONF-8409194—5). NTIS (US Sales Only), PC A03/MF A01. File Number DE85751626.

From 6. international workshop on photon-photon collisions; Lake Tahoe, CA, USA (9 Sep 1984).

After a brief general introduction into two-photon scattering processes the status of two-photon physics as of the beginning of this workshop is reported. Emphasis is given to those subjects which should get more attention in the future.

32577 (CBPF-NF—006/83) pp production cross sections and the constraint method. Anjos, J.C.; Santoro, A.F.S.; Souza, M.H.G.; Predazzi, E. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1983. 16p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85701441.

A method of constructing production cross sections that satisfy the constraints represented by the first few moments is shown to give an excellent account of the data when applied to the high energy pp production cross section ν sub(n) (s) plotted as functions of n.

32578 (CBPF-NF—008/83) Problems in accounting for the soft and hard components in transverse energy triggers. Anjos, J.C.; Santoro, A.F.S.; Souza, M.H.G.; Escobar, C.O. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1983. 11p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85701444.

It is argued that for a transverse energy trigger, the cancellation theorem of DeTar, Ellis and Landshoff is not valid. As a consequence, the problem of accounting for soft and hard components in this kind of trigger becomes complicated and no simple separation between them is expected.

32579 (CBPF-NF—024/83) **Twelve colourful stones.** Doria, R.M. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1983. 36p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85701445.

A dynamics with twelve colourful stones is created based on the concepts of gauge and colour. It is associated different gauge fields to the same group. A group of gauge invariant Lagrangians is established. A gauge invariant mass term is introduced. The colourful stones physical insight is building blocks for quarks and leptons.

32580 (CERN—84-10, pp 303-318) **Total cross section and diffractive processes at the large hadron collider (LHC).** Haguenauer, M.; Matthiae, G. (European Organization for Nuclear Research, Geneva (Switzerland)). 5 Sep 1984. NTIS (US Sales Only), PC A16/MF A01. File Number DE85701073. (CONF-8403162—Vol.1; ECFA—84/85).

From ECFA/CERN workshop on the possibility of a large hadron collider in the LEP tunnel; Lausanne, Switzerland (22 Mar 1984).

We first review the theoretical expectations on the total cross section, elastic scattering and diffraction dissociation in the multi-TeV energy range and then discuss the feasibility of the experiments at the Large Hadron Collider (LHC).

32581 (CERN—84-10, pp 319-322) **Production of masses in the forward cone: 'The angle of archeology'.** Ekeloef, T. (Uppsala Univ. (Sweden)). 5 Sep 1984. NTIS (US Sales Only), PC A16/MF A01. File Number DE85701073. (CONF-8403162—Vol.1; ECFA—84/85).

From ECFA/CERN workshop on the possibility of a large hadron collider in the LEP tunnel; Lausanne, Switzerland (22 Mar 1984).

Our conclusion of this study is that for the observation of masses below 1 TeV/c^2 that are produced through parton-parton fusion and decay into a pair of leptons or jets at a 9 + 9 TeV hadron collider, one should look in the forward-backward direction at polar angles below 40°. At the Fermilab collider of 1 + 1 TeV it will only be possible to explore the lower part of this mass region at low cross-section. At a 9 + 9 TeV collider, on the other hand, the cross-section over this whole mass region is considerable and the physics there would be open for detailed study provided that the forward-backward regions would be equipped with high quality detectors.

32582 (CERN—84-10, pp 323-326) **Theoretical predictions for pp and p anti p elastic scattering in the TeV energy domain.** Bourrely, C.; Martin, A. (European Organization for Nuclear Research, Geneva (Switzerland)). 5 Sep 1984. NTIS (US Sales Only), PC A16/MF A01. File Number DE85701073. (CONF-8403162—Vol.1; ECFA—84/85).

From ECFA/CERN workshop on the possibility of a large hadron collider in the LEP tunnel; Lausanne, Switzerland (22 Mar 1984).

We present theoretical predictions on total cross-sections and elastic scattering in the TeV energy domain obtained from the present experimental situation at the ISR and the panti p Collider.

32583 (CERN—84-10, pp 329-353) **Compositeness: The supercollider frontier.** Peccei, R.D. (Max-Planck-Institut fuer Physik und Astrophysik, Muenchen (Germany, F.R.). Werner-Heisenberg-Inst. fuer Physik). 5 Sep 1984. NTIS (US Sales Only), PC A16/MF A01. File Number DE85701073. (CONF-8403162—Vol.1; ECFA—84/85).

From ECFA/CERN workshop on the possibility of a large hadron collider in the LEP tunnel; Lausanne, Switzerland (22 Mar 1984).

With 51 refs. .

In this report I discuss some of the reasons which point towards this 'nearby compositeness', and examine some of the physical phenomena that are connected with substructure which could be explored at a Supercollider.

32584 (CERN—84-10, pp 354-358) **Lepton- and quark substructure at a multi-TeV-collider.** Fritzsch, H. (Muenchen Univ. (Germany, F.R.). Sektion Physik; Max-Planck-Institut fuer Physik und Astrophysik, Muenchen (Germany, F.R.). Werner-Heisenberg-Inst. fuer Physik). 5 Sep 1984. NTIS (US Sales Only), PC A16/MF A01. File Number DE85701073. (CONF-8403162—Vol.1; ECFA—84/85).

From ECFA/CERN workshop on the possibility of a large hadron collider in the LEP tunnel; Lausanne, Switzerland (22 Mar 1984).

There is no doubt that a hadron collider with $\sqrt{s}$ approx.= 20 TeV will be an extremely useful machine in studying the substructure of leptons, quarks and weak bosons. If Λsub(h) is of the order of 1 TeV or less, the chances are good to observe substructure effects at the CERN or FNAL colliders or at HERA. However details of an underlying substructure (e.g. the spectrums of excited quarks or leptons) can only be learned with a machine such as the one studied here in which the energies of the hard collisions of the quarks, gluons and/or leptons exceed 1 TeV.

32585 (CNRS-CPT—84-P-1608) **Electromagnetic mass differences between baryons in potential models.** Richard, J.M.; Taxil, P. (Centre National de la Recherche Scientifique, 13 - Marseille (France). Centre de Physique Theorique; Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). Apr 1984. 14p. (IPNO-TH—84-32). NTIS (US Sales Only), PC A02/MF A01. File Number DE85751291.

We calculate explicitely the electromagnetic mass splittings induced within the ground state baryons by the mass difference between the u and d quarks. This is performed in the framework of the non-relativistic potential model with an accurate treatment of the three-body problem. We also discuss the charge radius of the neutron.

32586 (DEMO—83/9) **Comparison of structure function data to the Lopez-Yndurain parametrizations.** Dris, M.; Karpathopoulos, S. (Democritos Nuclear Research Center, Athens (Greece)). Jun 1983. 22p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85701447.

We report on some results we get from fits of the Lopez-Yndurain parametrizations for structure functions to old CDHS and EMC data. These parametrizations are compatible with QCD, to leading order, at the end points and the relevant sum rules are properly imposed.

32587 (DESY—85-003) **Monopole-fermion and dyon-fermion bound states. Pt. 3.** Osland, P.; Tai Tsun Wu. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Jan 1985. Contract FG02-84ER40158. 31p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85751632.

In the first part of the paper, we give analytic, approximate results for the Kazama-Yang monopole-fermion binding energies and wave functions, valid for large values of A = 1/2 Zvertical strokeegvertical strokeK, where K is the extra magnetic moment. In the second part, more general results are obtained for the same problem that are valid when either A is large or the binding is weak. Numerical results for the binding energy are tabulated and compared.

32588 (DESY—85-004) **Monopole-fermion and dyon-fermion bound states. Pt. 4.** Osland, P.; Tai Tsun Wu. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Jan 1985. Contract FG02-84ER40158. 49p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85751631.

In the first part of the paper, we give analytic, approximate results for dyon-fermion binding energies and wave functions, valid for large values of A = 1/2 Zvertical strokeegvertical strokeK, where K is the magnetic moment. In the second part, more general results are obtained for the same problem that are valid when either A is large or the binding is weak. Numerical results for the binding energy are tabulated and compared. The case of very strong binding is also discussed.

32589 **(DESY—85-005) Correlations and static energies in the standard Higgs-model.** Montvay, I. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Jan 1985. 50p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85751630.

Correlations in the W-boson and Higgs-boson channels and the static energy of an external SU(2)-doublet charge pair are investigated by Monte Carlo calculations in the SU(2) lattice gauge theory with a Higgs-scalar doublet. The mass ratio msub(W)/msub(H) and the shape of the static potential are used to obtain information on the renormalization group trajectories in the three-dimensional coupling constant space. Numerical evidence shows that only two of the couplings are relevant. The phase transition line on the border of the Higgs-phase is weakly first order. A lower bound msub(H)/msub(W) >= 1.0 +- 0.3 is obtained for the ratio of the Higgs-boson mass to the W-boson mass.

32590 **(DOE/ER/40105—462) Duality of two-point functions for confined non-relativistic quark-antiquark systems.** Fishbane, P.M.; Gasiorowicz, S.G.; Kaus, P. (Virginia Univ., Charlottesville (USA). Dept. of Physics; Minnesota Univ., Minneapolis (USA). Dept. of Physics; California Univ., Riverside (USA). Dept. of Physics). [1985]. Contract AC02-83ER40105. 28p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85012334.

An analog to the scattering matrix describes the spectrum and high-energy behavior of confined systems. We show that for non-relativistic systems this S-matrix is identical to a two-point function which transparently describes the bound states for all angular momenta. Confined systems can thus be described in a dual fashion. This result makes it possible to study the modification of linear trajectories (originating in a long-range confining potential) due to short range forces which are unknown except for the way in which they modify the asymptotic behavior of the two point function. A type of effective range expansion is one way to calculate the energy shifts. 9 refs.

32591 **(DOE/ER/40105—T3) Relativistic wavefunction at the origin and the pion decay constant.** Haqq, E.; Suura, H. (Massachusetts Univ., Amherst (USA). Dept. of Physics and Astronomy; Minnesota Univ., Minneapolis (USA). School of Physics and Astronomy). [1985]. Contract AC02-83ER40105. 13p. (COO—1764-408). NTIS, PC A02/MF A01; GPO Dep. File Number DE85012392.

A hybrid Breit-Salpeter equation is studied for the pion. It is shown that the component of the Salpeter amplitude related to f/sub π/ is finite at the origin if the full relativistic equation is solved. This leads to an unambiguous calculation of f/sub π/. It is shown that this finiteness of the wavefunction is due to a suppression of the Coulomb potential whereby the 1/r singularity at the origin is reduced to a logarithmic one.

32592 **(DOE/ER/70004—T3) Should we expect large polarization effects at high energies.** Goldstein, G.R.; Moravcsik, M.J. (Tufts Univ., Medford, MA (USA). Dept. of Physics; Oregon Univ., Eugene (USA)). 1984. Contract AT06-76ER70004. 5p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85011499.

It is demonstrated that while in reactions at very high energies polarization quantities in which the polarization of only one particle is specified are likely to be small, due to dynamics-independent factors, for many of the kinematic configurations of interest, this is in no way indicative of other polarization quantities many of which could very well be very far from the trivial values of 0 or 1.

32593 **(EFI—675(65)-83) THETA-resonance photoproduction.** Shakhnazaryan, Yu.G. (Erevanskij Fizicheskij Inst. (USSR)). 1983. 14p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85701005.

Assuming that the recently observed at PETRA and SPEAR THETA(1650)- and THETA′(2100)-states are resonances in the rho^0 rho^0 system, possibility of their study in the photoproduction process γP→THETA(THETA′)p are discussed. The partial widths of decays THETA→rho^0 rho^0, $rho^0 \gamma$, $\gamma\gamma$ as well an the differential cross section $d\sigma/dt$ in pole approximation with rho^0-meson exchange are calculated for the case when the quantum numbers of these resonances are Jsup(PC)=Osp(++). The dependence of differential cross section on the production angle V in c.m.s. at some values of γ-quantum energy starting with the production threshold up to 10 GeV in lab as well as the dependence of the integral cross section on γ-quantum energy in the same energy region are plotted. The case when spin-parity of these resoances are Jsup(P)=2sup(+) is also discussed. The transitionvertex describing THETA→$rho^0\gamma$ decay has in this case three unknown coupling constants.

32594 **(IFT-P—01/84) Relativistic quark model.** Ferreira, P.L. (Instituto de Fisica Teorica, Sao Paulo (Brazil)). 1984. 17p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85701009.

A relativistic independent quark model whose single quark states obey a Dirac equation with an equal mixture of vector and scalar linear confining potential is discussed with particular emphasis in higher orbital excitations.

32595 **(IFVE-OTF-OEF—83-148) G(1590)-meson and possible characteristic features of a glueball.** Gershtejn, S.S.; Likhoded, A.K.; Prakoshkin, Yu.D. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1983. 10p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700663.

Submitted to the journal Z. Phys., C.

The scalar meson G(1590) is considered as a possible glueball. The decay mechanism, characteristic of a glueball, is proposed (the discolouring of gluons by gluons) which allows one to understand the increase of G → etaeta decay rate, as compared to the decays of G → $\pi\pi$ and G → K anti K, observed in the experiment. It is proposed to measure the ratio of branching ratios R=BR(G → etaeta′)/BR(G → etaeta) which is sensitive to the gluon content of G(1590). In the one-pion exchange model the predicted R values are within the range: 2 < or approximately R < or approximately 3.7.

32596 **(INIS-BR—252) Pion photoproduction in nucleons at low energies.** Carvalho, F.A.B.R. de. (Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Fisica). 1983. 97p. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. File Number DE85701440.

A new semiphenomenological analysis of the multipoles for pion photoproduction from nucleons, in the region of the first π-N resonance is presented. Through an energy dependent model, multipoles with isospin 1/2 and 3/2 and total angular momentum J < = 3/2 are determined.

32597 **(INIS-mf—9299, pp 84-87) Hadronic thermodynamics: Is there a limiting temperature.** Olive, K.E. (Fermi National Accelerator Lab., Batavia, IL (USA). Astrophysics Theory Group). 1984. NTIS (US Sales Only), PC A10/MF A01. File Number DE85780947. (CONF-840166—).

From 12. international workshop on gross properties of nuclei and nuclear excitations; Hirschegg, Austria (16 Jan 1984).

The hadron mass spectrum continues to be a topic of theoretical interest and will remain so until there can be some experimental verification in future heavy ion collisions. There are a variety of models such as the bootstrap, dual, bag etc., which all predict an exponentially rising density of states approx.= $\exp(m/T_0)$, T_0approx.=160 MeV. Once one assumes an exponential mass spectrum, one generally finds singularities in thermodynamic quantities and hence possibly a limiting temperature at T_0. In this talk, I point out some possible ways out of this dilemma. (orig./HSI).

32598 **(INIS-mf—9299, pp 125-128) Chiral symmetry breaking and the pion.** Brockmann, R. (Regensburg Univ. (Germany, F.R.). Inst. fuer Physik 1 - Theoretische Physik). 1984. NTIS (US Sales Only), PC A10/MF A01. File Number DE85780947. (CONF-840166—).

From 12. international workshop on gross properties of nuclei and nuclear excitations; Hirschegg, Austria (16 Jan 1984).

The relation between qanti q structure and the Goldstone Boson nature of the pion is analysed in a chiral effective Hamiltonian model. The physical pion mass is obtained with small but finite current quark masses msub(u)+msub(d)approx.=30 MeV in a way consistent with current algebra and QCD sumrules. The pion wave function is obtained as a superposition of qanti q pairs with a strong admixture of many-quark-many-antiquark components. The pion decay constants is calculated and found to be compatible with the experimental value for a qanti q valence rms radius of 0.4 fm. (orig.).

32599 (INIS-mf—9299, pp 171-173) **Nucleon-antinucleon interaction and the quark model.** Furui, S.; Faessler, A. (Tuebingen Univ. (Germany, F.R.). Inst. fuer Theoretische Physik). 1984. NTIS (US Sales Only), PC A10/MF A01. File Number DE85780947. (CONF-840166—).

From 12. international workshop on gross properties of nuclei and nuclear excitations; Hirschegg, Austria (16 Jan 1984).

We calculate the panti p annihilation at rest into mesons in the quark rearrangement model in which 3 quarks and 3 antiquarks rearrange into 3 mesons and in the quark annihilation model in which one or two quark-antiquark pairs are annihilated and a quark-antiquark pair is created. (orig./HSI).

32600 **(INIS-mf—9631) Twisted boundary conditions: a non-perturbative probe for pure non-abelian gauge theories.** Baal, P. van. (Rijksuniversiteit Utrecht (Netherlands)). 4 Jul 1984. 170p. NTIS (US Sales Only), PC A08/MF A01. File Number DE85780921.

Includes Dutch summary; 134 refs., 16 figs., 4 tabs.

In this thesis the author describes a pure non-abelian gauge theory on the hypertorus with gauge group SU(N). To test the flux tube picture he has studied the large distance limit of this theory, leading to a large coupling constant. To tackle this problem, he describes two approaches, in both of which twisted boundary conditions play an important role.

32601 **(ITEP—70(1983)) Quark-gluon model for particle production processes.** Volkovitskij, P.E. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1983. 20p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85701007.

The quark-gluon model for hadronization of strings produced in soft and hard processes is suggested. The model is based on the distribution functions of valence quarks in hadrons which have correct Regge behaviour. The simplest case is discussed in which only the longitudinal degrees of freedom are taken into account.

32602 **(ITEP—169(1983)) Calculation of the $D^+\to$ anti ksup(0)esup(+)ωsub(e) transition formfactor and the Usub(cs) element of the Kobajashi-Maskawa matrix.** Aliev, T.M.; Eletsky, V.L.; Kogan, Ya.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1983. 15p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85701006.

QCD sum rules for a three-point vertex function are used to determine the formfactor of vector current induced $D^+ \to$ anti K^0 transition. The following value is obtained fsub(+)sup(D → K) (0)=0.6+-0.1, as well as the constraint on the Usub(cs) element of the Kobayashimaskawa matrix, 0.9 < or approximately Usub(cs) < 0.97.

32603 **(JINR—E-2-84-12) Polarization effects in hadron fragmentation.** Lednicky, R. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1984. 6p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85701008.

Hadron polarization (spin alignment) and polarization asymmetry are discussed in terms of the quark recombination model with the spin-orbit interaction taken into account. It is shown that predictions of this model are at least in qualitative agreement with experimental data. Various polarization mechanisms in terms of this model and the possibility of their checking are also discussed.

32604 **(JINR—R-2-84-232) Nonleptonic decays of charged baryons in chiral theory (account for baryon poles).** Pervushin, V.N.; Sarikov, N.A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1984. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85701003.

A phenomenological chiral lagrangian for weak baryon-baryon transitions bringing about pole contributions into amplitudes of nonlepton baryon decays is constructed. It is shown that the account of pole contributions gives a satisfactory description of P-wave (parity-preserving) decay amplitudes of strange baryons. P-wave amplitudes for decays of charmed baryons are calculated.

32605 **(PUC-TN—01/83) Pion deuteron scattering and the ΔN interaction.** Dosch, H.G.; Andrade, S.C.B. de; Ferreira, E.M.; Munguia, G.P. (Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Fisica). 1983. 9p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85701442.

An analysis of π-d forward scattering yields an additional independent corroboration for a resonance at 2.15 GeV in the $^5S_2$, I=1, Δ-N channel.

32606 **(PUC-TN—24/83) Vertex function for pion-deuteron-dibaryon coupling.** Dosch, H.G.; Ferreira, E.M. (Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Fisica). Sep 1983. 37p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85701443.

The pion-deuteron-2^+ dibaryon vertex function and the influence on πd elastic scattering of a strong baryon-baryon interaction in the intermediate state are calculated. The general results of these investigation are the following. Near the ΔN threshold the contribution to the πd B_2 vertex function is largely dominated by the ΔN intermediate state. The vertex function falls off rapidly for energies above the ΔN threshold. The coupling of a possible 2^+ dibaryon resonance at 2.15 GeV to the πd system occurs mainly in an pound=1 wave. The contributions to πd helicity scattering amplitudes due to explicit ΔN interaction in the intermediate state are evaluated.

32607 **(PUC-TN—29/83) Quark model for baryons-negative parity states.** Amaral, M.G. do; Zagury, N. (Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Fisica). Nov 1983. 29p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85701446.

Under the assumption that quarks are confined by a relativistic central potential, $U(r)=1/2(1+\beta)(V_0+1/2Kr^2)$, and taking into consideration gluon exchange corrections, is calculated the mass spectrum for the negative-parity baryons.

32608 **(UM-P—84/41) Mechanism for coherent production of pions from the decay of resonances.** Lam, C.S.; Lo, S.Y. (Melbourne Univ., Parkville (Australia). School of Physics). 1984. 18p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85701002.

Conditions and signatures for the induced emission of bosons from a microscopic device are discussed. Detailed formulae for a simple two-level model are derived. In this model the decay of N Δ-resonances residing in a microscopic volume V is discussed. It is shown that large amplification factors for unusual charge bunching of pions are obtained as a result of induced emissions.

32609 **(UM-P—84/51) Primordial deuterium and neutrino decays.** McKellar, B.H.J.; Pakvasa, S. (Melbourne Univ., Parkville (Australia). School of Physics). 1984. 22p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85701004.

It is shown that Lindley's argument, that the primordial deuterium will be destroyed if there are neutrinos more massive than 5 MeV which decay into photons, can be extended to put limits on the photon branching ratio for neutrinos in the mass range 7.5 MeV -15 MeV. These limits are not satisfied by any models with a significant charged current coupling of the heavy neutrino to the electron.

32610 **(UWThPh—84-41) Proton decay in the potential model approach.** Falkensteiner, P.; Lucha, W.; Schoeberl, F. (Technische Univ., Vienna (Austria). 1. Inst. fuer Theoretische Physik). 1984. 6p. NTIS (US Sales Only), PC A02/ MF A01. File Number DE85701439.

A nonrelativistic potential model is employed for the discussion of proton decay. Within this potential model a numerical solution of the Schroedinger equation yields the meson wave functions, whereas the baryon wave functions are approximated by a superposition of Gaussian trial functions. The resulting energy level patterns of baryons as well as mesons are extremely satisfactory. Having this potential model at one's disposal one is able to drop the naive assumption of a spatial matrix element identical for all proton decay modes. The nucleon decay branching ratios are re-evaluated from the point of view of a realistic nucleon-meson overlap for different grand unified theories.

32611 **Possibility of searching for Higgs boson in t-quarkonium decays.** Chaichian, M.; Hayashi, M. (Department of High Energy Physics, University of Helsinki, Helsinki, Finland). *Physical Review* [*Section*] *D: Particles and Fields;* **32**: No. 1, 144-153(1 Jul 1985). Contract AC03-76SF00515.

We study the decays of t-quarkonium V, with particular attention to Higgs-boson production. Decay modes such as $V \to \gamma(,Z^0 \to)H\gamma$, $V \to \gamma(,Z^0 \to H$ $^3S_1(Y,psi)$, and $V \to Z^0 \to Hl^+l^-$ are also considered. These rates are found to be very small in the minimal (one-Higgs-doublet) model. We discuss shortly the consequences of a composite model for the Higgs boson and of enhanced coupling constants of a light Higgs boson to fermions in a two-Higgs-doublet scheme. The implications of a possible mixing between V and Z^0 on the production of V in e^+e^- collisions as well as in p-barp collisions are considered.

32612 **Looking for weak-boson compositeness via form factors.** Rizzo, T.G. (Ames Laboratory and Department of Physics, Iowa State University, Ames, Iowa 50011). *Physical Review* [*Section*] *D: Particles and Fields;* **32**: No. 1, 43-50(1 Jul 1985). Contract W-7405-ENG-82.

We examine the possibility that the composite structure of weak gauge bosons may first reveal itself through form-factor-like effects. We consider modifying the propagators and gauge-boson self-couplings with a simple parametrization of these composite-structure form factors, and examine a large number of processes where deviations from the standard model may be observed. Present data indicate the W, Z composite scale $\Lambda >$ or ≈ 0.1 TeV but future data from CERN LEP II may push $\Lambda > 1$ TeV. We find the process most sensitive to these form factors resulting from compositeness to be the reaction $e^+e^- \to W^+W^-$ because of the unique cancellations which take place in gauge theories.

32613 **Mixing of tt-bar bound states with the Z boson.** Franzini, P.J.; Gilman, F.J. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). *Physical Review* [*Section*] *D: Particles and Fields;* **32**: No. 1, 237-246(1 Jul 1985). Contract AC03-76SF00515.

We take seriously the possibility that tt-bar bound states are within several GeV/c^2 of the Z-boson mass and make a careful study of this possible near degeneracy using the mass-mixing formalism. Most of the decay width of vector states below the open-top threshold comes from mixing with the Z. In the idealized situation where there is no coupling of the unmixed tt-bar state to e^+e^- and ff-bar, the amplitude for $e^+e^- \to$ff-bar has an exact zero at the unmixed mass. Correspondingly, in the physical situation of nonzero couplings, the cross section for $e^+e^- \to$ff-bar exhibits deep minima. We investigate as well the effects of complex mixing matrix elements above the open-top threshold, and calculate longitudinal polarization and forward-backward asymmetries, where there are large enhancements near tt-bar resonance masses.

32614 **Mixing of a heavy neutrino with the electron neutrino.** Gilman, F.J.; Rhie, S.H. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). *Physical Review* [*Section*] *D: Particles and Fields;* **32**: No. 1, 324-326(1 Jul 1985). Contract AC03-76SF00515.

We show that recent monojet searches in electron-positron annihilation experiments can be used to extend significantly the limits on the mixing of a massive fourth-generation neutrino with the electron neutrino. When combined with other limits from hadron decays and secondary-vertex searches in hadron and electron-positron annihilation experiments, bounds of $'U_{14}'^2 <$ or $\approx 10^{-6}$ for neutrino masses of 10 MeV/c^2 to over 10 GeV/c^2 are obtainable by analysis of existing data.

32615 **Nonstandard Higgs bosons as a source of monojets.** Dawson, S.; Hinchliffe, I. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Physical Review* [*Section*] *D: Particles and Fields;* **32**: No. 1, 86-91(1 Jul 1985). Contract AC03-76SF00098.

Nonstandard Higgs-boson models are examined as a potential source for events with large missing P/sub t/ of the type recently seen by the UA1 group at CERN.

32616 **Systematics of πN scattering in chiral soliton models.** Mattis, M.P.; Peskin, M.E. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). *Physical Review* [*Section*] *D: Particles and Fields;* **32**: No. 1, 58-73(1 Jul 1985). Contract AC03-76SF00515.

We study the spin and isospin structure of pion-nucleon scattering amplitudes in the class of models, including the Skyrme model, in which the nucleon arises as a soliton built of pion fields. We derive general energy-independent linear relations among partial-wave amplitudes for the processes $\pi N \to \pi N$ and $\pi N \to \pi \Delta$ and show that these relations are in reasonably good agreement with experiment.

32617 **Nucleon-nucleus reactions at ultrarelativistic energies.** Wong, C. (Oak Ridge National Laboratory, Oak Ridge, Tennessee). *Physical Review* [*Section*] *D: Particles and Fields;* **32**: No. 1, 94-114(1 Jul 1985).

In order to discern coherent processes from incoherent and collective processes in nucleon-nucleus reactions at high energies, we study these reactions with an incoherent-multiple-collision model. In this model, the projectile nucleon makes successive inelastic collisions with nucleons in the target nucleus, the probability of such collisions being given by the thickness function and the nucleon-nucleon inelastic cross section. It is assumed that each baryon-baryon collision produces particles and degrades momenta just as a baryon-baryon collision in free space, and that there are no secondary collisions between the produced particles and the nucleons. We found that the inelastic proton data, the pseudorapidity distribution data dN/sup p/A/deta, and the total nucleon-nucleus absorption data can be well explained by the incoherent-multiple-collision model. However, the single-particle fragmentation data for nonleading particles indicate that there is a reduction of the fragmentation cross section because of subsequent collisions of the leading baryon along the collision chain. Modification of the incoherent-multiple-collision model is suggested. The modified model gives cross sections for the reactions $pA \to \pi^+X$, $pA \to \pi^-X$, $pA \to K^+X$, $pA \to K^-X$, and pA→p-barX in the projectile fragmentation region in good agreement with experiment.

32618 **Phenomenological coupling of excited lepton to Z^0 and Z^0 decay to hard γ.** Kalyniak, P.; Sundaresan, M.K. (Department of Physics, Carleton University, Ottawa, Ontario, Canada K1S 5B6 and Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). *Physical Review* [*Section*] *D: Particles and Fields;* **31**: No. 11, 2813-2817(1 Jun 1985). Contract AC03-76SF00515.

We explore the possibility of enhancing the decay $Z^0 \to e^+e\gamma$ with a hard photon through the existence of an excited spin-(1/2) lepton coupling to Z^0 and γ, while remaining consistent with constraints on these couplings from data on $e^+e^- \to \gamma\gamma$ and g-2. For an excited-lepton mass less than the Z^0 mass, we find that the rate can be enhanced but does not peak for high photon energies. We set lower limits on the couplings for the case of the excited lepton heavier than Z^0, as a function of mass of the heavy lepton.

32619 **New value for the electron asymmetry in $\Sigma \rightarrow ne\nu$ and hyperon semileptonic decays.** Bohm, A.; Kmiecik, M. (Center for Particle Theory, The University of Texas at Austin, Austin, Texas 78712). *Physical Review [Section] D: Particles and Fields;* **31**: No. 11, 3005-3007(1 Jun 1985).

Using the new value for *α*/sub e//sup Sigmaarrow-rightn/, fits of the hyperon-decay data are presented. They show that there is excellent agreement between the predictions of the Cabibbo model and the experimental data, except for perhaps two indications of minor corrections.

32620 **Soft hard scattering in the teraelectronvolt range.** Gaisser, T.K.; Halzen, F. (Physics Department, University of Wisconsin, Madison, Wisconsin 53706). *Physical Review Letters;* **54**: No. 16, 1754-1756(22 Apr 1985). Contract AC02-76ER00881.

Cross sections for the production of secondaries with large transverse momentum can become comparable to the total cross section in the teraelectronvolt energy range. We argue that the onset of this effect is observed at subteraelectronvolt energies via (i) an increase in the rapidity distribution near $y = 0$ (ii) an increase of <p/sub T/> with energy, and (iii) a correlation between <p/sub T/> and multiplicity. We discuss the implications for future hadron colliders and cosmic-ray experiments in the corresponding energy range.

32621 **Can relic neutrinos be observed.** Weiler, T. (Univ. of California, San Diego, La Jolla). *AIP (American Institute of Physics) Conference Proceedings;* No. 99, 60-75(1983). (CONF-820971—). Contract AS03-81ER40029.

From AIP conference on neutrino mass and gauge structure of weak interactions; Telemark, WI, USA (22 Sep 1982).

Within the framework of big-bang cosmology and the standard electroweak model, it appears that the only possibly detectable interaction of relic neutrinos is their annihilation with cosmic ray neutrinos on the Z resonance. However, measurement will require the existence of a large density of z ~ > 5 red-shifted sources with intense neutrino emission in the energy region 10^{21}eV^2/m/sub nu/.

6453 Particle Invariance Principles And Symmetries

REFER ALSO TO CITATION(S) 32635, 32658, 32879

32622 **(BONN-HE—84-26) Nicolai maps and stochastic observables from a coupling constant flow.** Dietz, K.; Lechtenfeld, O. (Bonn Univ. (Germany, F.R.). Physikalisches Inst.). Oct 1984. 38p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85751138.

Coupling constant flow equations are derived for supersymmetric scalar and gauge theories. These equations then serve as a starting point for the construction of Nicolai maps. From the fixed-point properties of the latter we establish a large class of stochastic functionals.

32623 **(IFT-P—10/83) P and T violations in QED.** Pleitez, V. (Instituto de Fisica Teorica, Sao Paulo (Brazil)). 1983. 32p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85700984.

An abelian gauge theory with violation of P and T symmetries, is constructed other features of usual spinor quantum electrodynamics are maintained. The theory is applied to some scattering processes with polarized and unpolarized electrons.

32624 **(PUC-TN—19/83) Phase diagram of the Z(4)-model.** Baltar, V.L.; Carneiro, G.M.; Pol, M.E.; Zagury, N. (Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Fisica). 1983. 24p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85701408.

Systems with Z(4) global symmetry defined on a square lattice are studied both by Monte Carlo simulations and by the Migdal-Kadanoff renormalization group scheme. A phase diagram is obtained with quantitative predictions as to the location of the boundaries between the different phases. Four distinct phases are observed.

32625 **(PUC-TN—26/83) Dynamical symmetry breakdown in SU(5) and SO(10).** Shellard, R.C. (Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Fisica). Sep 1983. 9p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. File Number DE85701409.

Some restrictions imposed upon Grand Unified Theories by dynamical symmetry breakdown are examined. It is observed in particular, that theories with SU(5) as symmetry group, with 3 or more fermion families undergo dynamical symmetry breakdown, and some of the fermions will acquire mass at the Grand Unified scale. On the other hand, the SO(10) group, with 3 families is free from this problem.

32626 **Unique chiral three-preon model of quarks and leptons.** Gipson, J.M.; Tosa, Y.; Marshak, R.E. (Physics Department, Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061). *Physical Review [Section] D: Particles and Fields;* **32**: No. 1, 284-292(1 Jul 1985).

A unique chiral three-preon model of quarks and leptons is deduced without referring to the resulting composite states. This model is based on the gauged E_6xSO(10) preon symmetry where E_6 and SO(10) are the metacolor and color-flavor groups, respectively. The model has several notable features. The anomalies of the underlying theory are reproduced by pseudo-Goldstone bosons which acquire masses on the SO(10) scale. The model predicts three generations of ordinary quarks and leptons when SO(10) descends to the standard group through SU(4)/sub C/ x SU(2)/sub L/ x SU(2)/sub R/ but not through SU(5) x U(1). It can explain the correct ordering of the gauge hierarchy in terms of the preonic structure of the Higgs composites. The model predicts a large number of exotic fermionic composites at relatively low energies.

32627 **Supersymmetric models for quarks and leptons with nonlinearly realized E_8 symmetry.** Ong, C.L. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). *Physical Review [Section] D: Particles and Fields;* **31**: No. 12, 3271-3279(15 Jun 1985). Contract AC03-76SF00515.

We propose three supersymmetric nonlinear *σ* models with global symmetry E_8. The models can accommodate three left-handed families of quarks and leptons without incurring the Adler-Bell-Jackiw anomaly with respect to either the standard SU(3) x SU(2) x U(1) gauge group, or the SU(5), or SO(10) grand unifying gauge group. They also predict unambiguously a right-handed, fourth family of quarks and leptons. In order to explore the structure of the models, we develop a differential-form formulation of the Kahler manifolds, resulting in general expressions for the curvature tensors and other geometrical objects in terms of the structure constants of the algebra, and the squashing parameters. These results, in turn, facilitate a general method for determining the Lagrangian to quartic order, and so the structure of the inherent four-fermion interactions of the models. We observe that the Kahlerian condition $d\omega = 0$ on the fundamental two-form ω greatly reduces the number of the independent squashing parameters. We also point out two plausible mechanisms for symmetry breaking, involving gravity.

32628 **Nicolai maps on manifolds.** Claudson, M.; Halpern, M.B. (Department of Physics, University of California, Berkeley, California 94720). *Physical Review [Section] D: Particles and Fields;* **31**: No. 12, 3310-3313(15 Jun 1985). Contract AC03-76SF00098.

In spite of the presence of quartic fermion interactions, we construct Nicolai maps for the empty and filled sectors of the $N = 2$ supersymmetric *σ* model in $1+0$ dimensions. The maps form covariant Langevin-Fokker-Planck systems on arbitrary manifolds without boundary and describe Brownian motion along geodesics. On compact manifolds, these stochastic systems always equilibrate to the probability densities of the empty and filled supersymmetric ground states.

32629 **Nonminimal SU(5) model.** Huebsch, T.; Meljanac, S.; Pallua, S. (Zavod za Teorijsku Fiziku, Prirodoslovno-Matematiki Fakultet, University of Zagreb, Marulicev trg 19, 41000 Zagreb, Croatia, Yugoslavia). *Physical Review [Section] D: Particles and Fields;* **31**: No. 11, 2958-2963(1 Jun 1985). Contract AC03-76SF00515.

The existence of the solution of the symmetry-breaking problem SU(5)→SU(3) x SU(2) x U(1)/sub Y/→SU(3) x U(1)/sub Q/ is shown in a nonminimal model where the 75-dimensional Higgs field is used instead of the usual 24-dimensional one. The result is given in an explicit and simple form. The relevance of this solution to existing theories and to problems related to proton decay is discussed.

32630 **Model for maximal CP nonconservation.** Gronau, M.; Johnson, R.; Schechter, J. (Physics Department, Technion, 32000 Haifa, Israel). *Physical Review Letters;* **54**: No. 20, 2176-2179(20 May 1985). Contract AC02-76ER03533.

We display a model for the up and down quark mass matrices which permits, for any number of generations, the complete determination of the Kobayashi-Maskawa matrix in terms of the quark masses. We discuss in this framework the correlation between the quark mass spectrum and a maximal CP-nonconserving phase and also give an application to the four-generation case.

32631 **Supersymmetric quantum mechanics and large-N expansions.** Imbo, T.D.; Sukhatme, U.P. (Department of Physics, University of Illinois at Chicago, Chicago, Illinois 60680). *Physical Review Letters;* **54**: No. 20, 2184-2187(20 May 1985). Contract FG02-84ER40169.

Supersymmetric quantum mechanics is formulated for spherically symmetric potentials in N spatial dimensions. It is seen that the supersymmetric partner potential of a given potential can be effectively treated as being in N+2 dimensions. This fact is exploited in calculations using the shifted 1/N expansion. Also, the violation of the no-degeneracy theorem in one dimension by the Coulomb potential is seen as a consequence of this result.

6454 Field Theory

REFER ALSO TO CITATION(S) 32600, 32615, 32627, 32629, 32753

32632 **(CBPF-NF—011/83) Gauge effect: an application to the electron self energy.** Doria, R.M. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1983. 19p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85701400.

The influence of the gauge rotation in perturbation theory is investigated. As an example, the fermion propagator is studied in a gauge invariant form. The calculation is parametrized for a straight line. A guage independent renormalization constant is obtained.

32633 **(CBPF-NF—017/83) Fourier analysis and Wilson loops.** Bollini, C.G.; Giambiagi, J.J. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1983. 13p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85701401.

The quantum average of the Wilson Loop is computed through Fourier analysis of the potentials and functional integration over the coefficients. Simple results are obtained in the Abelian case as well as in the N → finite limit of the non-Abelian theory.

32634 **(CBPF-NF—021/83) Simplified chiral superfield propagators for chiral constant mass superfields.** Srivastava, P.P. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1983. 8p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85701402.

Unconstrained superfield potentials are introduced to derive Feynman rules for chiral superfields following conventional procedure which is easy and instructive. Propagators for the case when the mass parameters are constant chiral superfields are derived. The propagators reported here are very simple compared to those available in literature and allow a manageable calculation of higher loops.

32635 **(CONF-820466—4) Supersymmetry, grand unification and proton decay.** Rudaz, S. (Minnesota Univ., Minneapolis (USA). School of Physics and Astronomy). 1982. Contract AC02-83ER40105. 15p. (COO—1764-439). NTIS, PC A02/MF A01; GPO Dep. File Number DE85012395.

From 3. workshop on grand unification; Chapel Hill, NC, USA (15 Apr 1982).

In this talk, some phenomenological issues were reviewed pertaining to supersymmetric grand unified theories (SUSY GUTs), with special emphasis on new features for proton decay. 18 refs.

32636 **(CTA-IEAV-RP—020/82) Reflection of radially symmetrical sine-Gordon kinks in the origin.** Geicke, J. (Centro Tecnico Aeroespacial, Sao Jose dos Campos (Brazil). Inst. de Estudos Avancados). May 1983. 11p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700980.

An explanation is given for the known numerical result that a spherical 2π-kink is reflected in $r = O$ as a kink (and not as an antikink like in one space dimension). In circular symmetry 2π-kinks are studied numerically. Besides the pulsons arising for small energies, no reflection is observed in $r = O$.

32637 **(CTA-IEAV-RP—021/82) Cylindrical pulsons in nonlinear relativistic wave equations.** Geicke, J. (Centro Tecnico Aeroespacial, Sao Jose dos Campos (Brazil). Inst. de Estudos Avancados). Jan 1982. 16p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700981.

Numerical results to the Higgs scalar equation and the sine-Gordon equation with cylindrical symmetry are reported. Two separated energy regions are found where a Higgs kink develops into pulsons when reaching the origin $r = 0$, while only for higher energies a reflection is observed. The pulsons to both equations are studied in detail by modifying the initial kink shapes. In comparison with the spherical pulsons the cylindrical ones are extremely long-lived. For amplitudes slightly below half the distance between two (neighboured) vacua of the theories no decrease of the amplitudes and no perceivable radiation have been obtained by the numerical solution, examined during a time of order 1000. On the other hand, 'heavy' sine-Gordon pulsons (with amplitudes 3π - 4π) are found to decay fast during a time $t = 100$ in cylindrical symmetry.

32638 **(DESY—84-117) Light leptoquarks.** Schrempp, B.; Schrempp, F. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Dec 1984. 15p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85751637.

The case is made for light spinless leptoquarks of the Goldstone boson type (m << Gsub(F)sup(-1/2)) in the framework of nearby compositeness and special technicolor schemes. Their expected experimental signatures are worked out in the light of recently observed anomalous events of the type μ^+ jet μ^- jet, 'monojet' and 'monophoton'.

32639 **(DOE/ER/70004—T2) Hierarchies in grand unification.** Johnson, R.J. (Oregon Univ., Eugene (USA). Inst. of Theoretical Science). Jun 1984. Contract AT06-76ER70004. 83p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85011480.

The theoretical aspiration of unifying all interactions through the mechanism of a spontaneously broken gauge symmetry received some encouragement recently with the discovery of the W^{+-} and Z^0 electroweak bosons predicted in the Glashow-Weinberg-Salam model of spontaneously broken SU/sub L/(2)xU/sub Y/(2). However the null results from proton decay experiments have dampened the hope that SU(5) is the correct model and placed some doubt on whether experimental evidence for grand unification can ever be seen. This situation has prompted us to look for other tests of grand unification and in particular to examine the possibility and testability of models larger than SU(5) which can have intermediate scales of symmetry breaking. We have studied some low energy models containing two light Z bosons and confronted them with the electroweak neutral current data to determine whether or not they can consistently fit it and if so what it implies for the masses of the Z bosons. The electroweak neutral currents also provide us with information on the low energy values of the gauge couplings which we used to establish limits on the hierarchy scales in an SO(10) model. Finally we discuss the theoretical fine tuning problem that arises in any model with a large scale hierarchy. The problem lies in the Higgs sector and can be related to the existence of quadratic divergences in the Higgs mass parameter. A "naturalness" criterion for a grand unified theory requires the absence of these quadratic divergences in order to make the hierarchy stable under radiative corrections. We show in a large class of renormalizable quantum field theories that if there occurs a cancellation of quadratic divergences for the scalar mass terms, then the only interaction structure allowed is that of supersymmetry. 63 refs.

32640 (INIS-mf—9299, pp 144-152) **(Confinement) structure of Yang-Mills-theories within a Bose-BCS-theory.** Schuette, D. (Bonn Univ. (Germany, F.R.). Inst. fuer Theoretische Kernphysik). 1984. NTIS (US Sales Only), PC A10/MF A01. File Number DE85780947. (CONF-840166—).

From 12. international workshop on gross properties of nuclei and nuclear excitations; Hirschegg, Austria (16 Jan 1984).

It is the purpose of this talk to report on a first attempt to apply (non-perturbative) techniques of many-body theory to a field-theory of the Yang-Mills-type. The procedure is in principle analogous to lattice calculations: In order to make the field-theoretical hamiltonian a well-behaved operator in the Fock-space, a phase-space-cutoff is assumed for the definition of the field operators. The coupling constant g then becomes a function of this cutoff which is fixed by some physical property like a glue-ball mass. (orig./HSI).

32641 (INIS-mf—9299, pp 153-155) **Simplified scheme for Yang-Mills variational calculations.** Polley, L. (Technische Hochschule Darmstadt (Germany, F.R.). Inst. fuer Kernphysik). 1984. NTIS (US Sales Only), PC A10/MF A01. File Number DE85780947. (CONF-840166—).

From 12. international workshop on gross properties of nuclei and nuclear excitations; Hirschegg, Austria (16 Jan 1984).

At the present status of QCD, one would be content with only a rough analytic estimate of ground state levels in the various flavour sectors, so the Rayleigh-Ritz method seems promising. Unfortunately, the method encounters many problems in QCD, of which only one is addressed here. (orig./HSI).

32642 (INIS-mf—9299, pp 157-159) **Microcanonical simulation of QCD with quarks.** Polonyi, J. (Illinois Univ., Urbana (USA)). 1984. NTIS (US Sales Only), PC A10/MF A01. File Number DE85780947. (CONF-840166—).

From 12. international workshop on gross properties of nuclei and nuclear excitations; Hirschegg, Austria (16 Jan 1984).

I give first a brief outline of this microcanonical method and after that some preliminary results obtained in lattice QCD in collaboration with J. Kogut and H.W. Wyld. (orig./HSI).

32643 (INIS-mf—9299, pp 160-166) **Analysis of the Z(N) strong coupling model fo the SU(N) deconfinement transition.** Karsch, F. (European Organization for Nuclear Research, Geneva (Switzerland)). 1984. NTIS (US Sales Only), PC A10/MF A01. File Number DE85780947. (CONF-840166—).

From 12. international workshop on gross properties of nuclei and nuclear excitations; Hirschegg, Austria (16 Jan 1984).

In the strong coupling limit the SU(N) gauge model at finite temperature reduces to an effective Z(N)-symmetric spin model for the thermal Wilson-line. Within the framework of this model we determine the order of the SU(N) deconfinement transition and study the influence of fundamental matter fields on this transition: We find a second order phase transition for SU(2) and first order transitions for all SU(N), N>=3. In the presence of sufficiently light particles in the fundamental representation this transition gets destroyed. (orig.).

32644 (INIS-mf—9299, pp 156) **Status of deconfinement in lattice QCD.** Satz, H. (Bielefeld Univ. (Germany, F.R.)). 1984. NTIS (US Sales Only), PC A10/MF A01. File Number DE85780947. (CONF-840166—).

From 12. international workshop on gross properties of nuclei and nuclear excitations; Hirschegg, Austria (16 Jan 1984).

Published in summary form only.

32645 (INIS-mf—9299, pp 167-170) **Virtual quark loops and the phase transitions in lattice quantum chromodynamics at finite temperature.** Gavai, R.V. (Bielefeld Univ. (Germany, F.R.). Zentrum fuer Interdisziplinaere Forschung; Bielefeld Univ. (Germany, F.R.). Fakultaet fuer Physik); Lev, M.; Petersson, B. (Bhabha Atomic Research Centre, Bombay (India). Chemical Engineering Div.). 1984. NTIS (US Sales Only), PC A10/MF A01. File Number DE85780947. (CONF-840166—).

From 12. international workshop on gross properties of nuclei and nuclear excitations; Hirschegg, Austria (16 Jan 1984).

Using the pseudofermion Monte Carlo method we investigate the chiral and the deconfinement phase transitions in the SU(3) gauge theory with dynamical staggered fermions on a 6^3x2 lattice. Both the energy density of the gluonic sector epsilonsub(G) and the order parameter <PSI anti PSI> are found to have a rapid variation in $\beta(=6/g^2)$, which is similar to that observed in the quenched theory but at a smaller value of β. (orig.).

32646 (INIS-mf—9648) **Measuring the dimension of space-time.** Zeilinger, A.; Svozil, K. (Atominstitut der Oesterreichischen Universitaeten, Vienna). 1984. 8p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85701403.

Operationalistic definition of the dimension of space-time leads to the possibility of its experimental determination. Several reasons may be given for the fractional dimension of space-time to be slightly smaller than four, yielding a finite quantum electrodynamics.

32647 (ITF—83-113-R) **Effective Lagrangian in two-dimensional electrodynamics with anomalous moment.** Rusev, D.G.; Gusynin, V.P.; Fomin, P.I. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). Oct 1983. 14p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85700982.

The effective Lagrangian for the two-dimensional electrodynamics with anomalous magnetic moment is evaluated. Basing on the obtained expression the effects of pair production by external field and the vacuum stability of the model are investigated.

32648 (JINR—E-2-84-11) **Conformally invariant equation for the symmetric tensor field.** Leonovich, A.A.; Nesterenko, V.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1984. 8p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700983.

A conformally invariant equation of the second order for the symmetric tensor field in the Riemannian space of an arbitrary dimension is suggested. The operator of the conformal momentum acting in the space of solutions of this equation is constructed. It is shown that the trace of the energy-momentum tensor vanishes.

32649 (PUC-TN—18/83) **Introduction to Quantum Chromodynamics.** Shellard, R.C. (Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Fisica). Jun 1983. 73p. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. File Number DE85701404.

A pedagogical over view of Quantum Chromodynamics, emphasying its pertubative as well as its non-pertubative aspects is given. The renormalization group; aplications of QCD to parton models, gauge theories in a lattice, instantons and the theta angle and problems associated to chiral symmetry breaking are studied.

32650 (PUC-TN—21/83) **Breakdown of the 1/N expansion in the continuum limit of strong coupling lattice QCD.** Bralic, N.; Loewe, M. (Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Fisica). Aug 1983. 17p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85701405.

The restoration of Lorentz covariance in the continuum limit of strong coupling lattice QCD is shown to require the breakdown of the 1/N expansion. With the leading 1/N appoximation becoming irrelevant in that limit. To leading order in 1/N Lorentz convariance can be restored only as an approximate long distance symmetry a non conventional continuum limit with a non Hermitian-Hamiltonian.

32651 **(PUC-TN—22/83) Monte Carlo method in field theories.** Carvalho, C.A. de. (Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Fisica). Aug 1983. 20p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. File Number DE85701406.

An introduction to the Monte Carlo method in field theories is presented and, as an example, its application to the study of lambda phi 4 theory is discussed.

32652 **(PUC-TN—23/83) Domain walls at finite temperature.** Carvalho, C.A. de; Marques, G.C.; Silva, A.J. da; Ventura, I. (Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Fisica). Aug 1983. 38p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85701407.

It is suggested that the phase transition of lambda phi 4 theory as a function of temperature coincides with the spontaneous appearance of domain walls. Based on one-loop calculations, T sub(c) = 4M/√ lambda is estimated as the temperature for these domains to because energetically favored, to be compared with T sub(c) = 4.9M/√ lambda from effective potential calculations (which are performed directly in the broken phase). Domain walls, as well as other Types of fluctuations, disorder the system above T sub(c), leading to <phi>=0. The critical exponent for the specific heat above T sub(c) is computed; and α=2/3 + 0 (√ lambda) is obtained.

32653 **Gauge field propagator for QED and linearized QCD in inhomogeneous media.** Bickeboeller, M.; Goldflam, R.; Wilets, L. (Institute for Nuclear Theory, Department of Physics, FM-15, University of Washington, Seattle, Washington 98195). *Journal of Mathematical Physics (New York);* **26**: No. 7, 1810-1817(Jul 1985).

The gauge field propagator is calculated in configuration space using an expansion in spherical harmonics for the scalar Green function and in vector spherical harmonics for the tensor Green function. We work in the Coulomb gauge where the scalar Green function is instantaneous and the frequency-dependent tensor Green function is transverse. Explicit expressions are obtained to solve for the propagators in the presence of inhomogeneous dielectric media.

32654 **Exact ground-state properties of the SU(2) Hamiltonian lattice gauge theory.** Chin, S.A.; van Roosmalen, O.S.; Umland, E.A.; Koonin, S.E. (Department of Physics, University of California at Los Angeles, Los Angeles, California 90024). *Physical Review [Section] D: Particles and Fields;* **31**: No. 12, 3201-3212(15 Jun 1985). Contract AC02-76ER03074.

The SU(2) Hamiltonian lattice gauge theory is shown explicitly to be equivalent to a nonrelativistic quantum many-body problem in S^3. By exploiting this equivalence, a many-body Monte Carlo algorithm is devised to solve for its ground-state properties. To the extent that a trial wave function consisting of a product of single-plaquette functions is a good approximation to the exact ground state, the present Monte Carlo method is shown to be an efficient means of calculating the ground-state energy with high precision.

32655 **Axial and parity anomalies and vacuum charge: A direct approach.** Boyanovsky, D.; Blankenbecler, R. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). *Physical Review [Section] D: Particles and Fields;* **31**: No. 12, 3234-3250(15 Jun 1985). Contract AC03-76SF00515.

We study the axial and parity anomalies in Abelian gauge theories using the direct yet intuitive approach of counting the relative number of states of one chirality with respect to the other. A fundamental gauge-invariant quantity, the determinantal ratio, is introduced for this purpose. We find that the number of states is conserved and that the gauge fields differentially phase shift states of opposite chirality at infinite energies. This implies a relative flow of states at very large energies which must be compensated by a rearrangement of the density of states at finite energies. We then derive a sum rule which yields two alternative formulas for the index of a Dirac operator. One expresses the index in terms of its high-energy behavior, and the other in terms of the low-energy properties; these are the "zero modes" of definite chirality. Two examples are worked out in detail to clarify our general result. The physics of the axial anomaly is shown to translate into that of the parity anomaly in 2+1 dimensions, in which parity and chirality have interchanged roles. We also analyze the vacuum charge in regard to its high- and low-energy origin. The possibility of spectral flow is formulated and briefly discussed. In short, we provide a physical interpretation of certain mathematical indices, relate them to an extended version of Levinson's theorem of potential scattering, and simplify their evaluation.

32656 **Localization of the dyon charge.** Sen, A.; Yamagishi, H. (Fermi National Accelerator Laboratory, P.O. Box 500, Batavia, Illinois 60510). *Physical Review [Section] D: Particles and Fields;* **31**: No. 12, 3285-3287(15 Jun 1985). Contract AC02-76ER03069.

We consider three possible expressions for the dyon charge in the presence of fermions. We find that although none of them fully admit an interpretation as a localized charge, one expression may be identified as the core charge under suitable conditions. Comparison with Callan's expressions are also made.

32657 **Crossover from strong to weak coupling in lattice gauge theory with dynamical fermions.** Kogut, J.B.; Polonyi, J.; Wyld, H.W.; Sinclair, D.K. (Department of Physics, University of Illinois at Urbana-Champaign, 1110 West Green Street, Urbana, Illinois 61801). *Physical Review [Section] D: Particles and Fields;* **31**: No. 12, 3304-3306(15 Jun 1985).

Using microcanonical simulation techniques we study SO(3) gauge theory with dynamical quarks and contrast the results with quenched simulations. We measure the expectation values of the gauge action, psi-barpsi, and the Z_2 monopole current density. We locate the first-order bulk transition in the quenched case by exhibiting metastable states and find that the effect of the light dynamical fermions on the transition is simply a shift in the critical coupling.

32658 **Thermodynamics of SU(2) gauge theory with dynamical, light fermions.** Kogut, J.B.; Polonyi, J.; Wyld, H.W.; Sinclair, D.K. (Department of Physics, University of Illinois at Urbana-Champaign, 1110 West Green Street, Urbana, Illinois 61801). *Physical Review [Section] D: Particles and Fields;* **31**: No. 12, 3307-3309(15 Jun 1985).

Using microcanonical computer-simulation techniques we study the finite-temperature phase transitions in SU(2) gauge theory with four light-quark species. The chiral-symmetry-restoration transition is found by studying the order parameter <psi-barpsi>. The theory's Wilson line, Wilson-line correlation function, and internal energies are measured in the vicinity of the transition. The Wilson line and its correlation function are smooth, apparently analytic functions of the physical temperature. These results are contrasted with their SU(3) counterparts.

32659 **Second-order fermion masses.** Leung, C.N.; Robinett, R.W.; Rosner, J.L. (Univ. of Minnesota, Minneapolis). *AIP (American Institute of Physics) Conference Proceedings;* No. 99, 202-206(1983). (CONF-820971—). Contract AC02-76ER01764;AC02-82ER40073.

From AIP conference on neutrino mass and gauge structure of weak interactions; Telemark, WI, USA (22 Sep 1982).

An SO(10) model with the lowest-energy symmetry breaking arising from two members of a 16-plet of Higgs bosons can lead to fermion masses if, in addition to fermion 16-plets, there are heavy fermions belonging to SO(10) singlets. Some consequences of this model for neutrino masses are explored briefly.

65 PHYSICS. II.

32660 **(INIS-mf—9632) Programme of the autumn meeting of the Dutch Society of Physics held at ECN, Petten, October 19, 1984.** (Nederlandse Natuurkundige Vereniging, Utrecht). 19 Oct 1984. 12p. (CONF-8410253—Summ.). NTIS (US Sales Only), PC A02/MF A01. File Number DE85780923.

From Autumn meeting of the Dutch Association of Physics; Petten, Netherlands (19 Oct 1984).

Published in summary form only.

Separate abstracts were prepared for the data base for the papers presented. (WHK)

6510 Nuclear Physics

REFER ALSO TO CITATION(S) 31708, 32803

32661 **(AECL—7778) Progress report: Physics Division, 1982 April 1-June 30.** (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Aug 1982. 141p. (PR-P—134). NTIS (US Sales Only), PC A07/MF A01. File Number DE85701528.

Nuclear physics studies that took place at Chalk River Nuclear Laboratories during the second quarter of 1982 are described, as well as work in solid state and theoretical physics. The MP Tandem accelerator was shut down to prepare for the installation of a superconducting cyclotron. Computer codes developed during the period and the operation of the computer facilities are described.

32662 **(INIS-mf—9299) Gross properties of nuclei and nuclear excitations. Proceedings.** Feldmeier, H. (ed.). (Technische Hochschule Darmstadt (Germany, F.R.). Inst. fuer Kernphysik; Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). 1984. 211p. (CONF-840166—). NTIS (US Sales Only), PC A10/MF A01. File Number DE85780947.

From 12. international workshop on gross properties of nuclei and nuclear excitations; Hirschegg, Austria (16 Jan 1984).

These proceedings contain the articles presented at the named workshop. These concern theoretical and experimental studies on nuclear matter, heavy ion reactions, relativistic nuclear physics, and the theory of strong interactions. Separate entries were prepared for the data base for the papers included.

32663 **(INIS-mf—9630) NIKHEF annual report 1983.** (Nationaal Inst. voor Kernfysica en Hoge-Energiefysica (NIKHEF), Amsterdam (Netherlands)). Sum 1984. 73p. (In Dutch). NTIS (US Sales Only), PC A04/MF A01. File Number DE85780920.

This annual report of NIKHEF, Amsterdam (Netherlands) describes experiments carried out at CERN (Geneve), DESY (Hamburg) viz. WA25; CHARM-collaboration; ACCMOR experiments; proton-antiproton collision; LEAR; MARK-J; Crystal Ball experiment; HERA. For the nuclear physics section, experiments are described on electro-excitation of nuclei; pion and muon physics. Theoretical studies are listed concerning electromagnetic interactions in the sigma-omega model and delta-nuclei dynamics. A radiochemical and technical part concludes the report.

32664 **(INIS-mf—9651) Progress report 1983/1984 of the Institute for Theoretical Physics of University of Graz, Austria.** Pucker, N. (ed.). (Graz Univ. (Austria)). Dec 1984. 27p. (In German). NTIS (US Sales Only), PC A03/MF A01. File Number DE85701533.

The research fields of the institute are presented 1) electromagnetic processes in external fields 2) quantum mechanics and field theory 3) elementary particle theory 4) mathematical physics 5) many-particle and nuclear physics 6) semiconductor physics 7) energy and fundamentals of nuclear energies.

32665 **(INS-R—305) Nuclear Physics Group progress report July-December 1981.** Coote, G.E. (ed.). (Department of Scientific and Industrial Research, Lower Hutt (New Zealand). Inst. of Nuclear Sciences). Dec 1982. 10p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85701534.

The work of the Nuclear Physics Group of the Institute of Nuclear Sciences during the period July-December 1981 is described.

32666 **(KIYI—83-12) Nuclear and physical researches on the isochronous cyclotron U-240 during 1982.** (AN Ukrainskoj SSR, Kiev. Inst. Yadernykh Issledovanij). 1983. 36p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. File Number DE85781033.

Separate entries were prepared for the data base for the papers presented. (HK)

6512 Nuclear Properties And Reactions, A=1-5

REFER ALSO TO CITATION(S) 32667, 32668, 32674, 32690

32667 **(DOE/ER/40030—4A) Medium energy measurements of n-n parameters. Progress in research, January 1-December 31, 1984.** (Texas Univ., Austin (USA). Dept. of Physics). Dec 1984. Contract AS05-81ER40030. 36p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85007065.

The purpose of this report is to summarize our progress in medium energy research during 1984. Our research program is one principally involving medium energy nucleon-nucleon experiments at LAMPF. It is collaborative effort involving the University of Texas, Los Alamos National Laboratory, and other research groups, most notably the UCLA Medium Energy Physics group. The aim of the experimental program is the determination of the nucleon-nucleon amplitudes at medium energy. The required data include both elastic and inelastic experiments, and in addition the measurements of polarization and polarization transfer parameters. The progress reported here is progress involving the collaborative research program as a whole. We emphasize the research work that the University of Texas group is most concerned with. Publications are listed.

32668 **(INIS-mf—9303) Study of the energy and angular dependence of the final state interaction (αn) in the reaction ^{4}He(d,pα)n with polarized deuterons.** Oswald, H. (Koeln Univ. (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet). 17 Dec 1983. 79p. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE85780925.

With 43 refs.

In a complete coincidence experiment the reaction ^{4}He(d vector, p α)n was measured at different deuteron incident energies. Thereby in a range of kinematical situations of the final state interaction (FSI) of the α-n subsystem the dependence on the incident energy between 6 and 11 MeV (thetasub(cm)(FS)=111°) and production angles between 90° and 140° (Esub(d)=7 MeV) was systematically studied. Beside the absolute differential cross sections also the vector analyzing powers Asub(y) and for one incident energy (Esub(d)=10 MeV) also the tensor analyzing power Asub(zz) were determined. The data were compared with Faddeev calculations on the α-d system of Koike. The agreement is generally good for the analyzing power. The cross section is qualitatively reproduced with large quantitative deviations for the low incident energies and good agreement at Ed>=10 MeV. The measurements suggest to improve the simple potentials and the crude regardment of the Coulomb interaction in the theoretical calculations. (HSI).

32669 (INIS-mf—9632, pp 3) **Direct deuteron knockout in ^{3}He(e,e'd)p.** Keizer, P.H.M.; Brand, J.F.J. van den; Dunn, P.C. (Nationaal Inst. voor Kernfysica en Hoge-Energiefysica (NIKHEF), Amsterdam (Netherlands). Sectie K). 19 Oct 1984. NTIS (US Sales Only), PC A02/MF A01. File Number DE85780923. (CONF-8410253—Summ.).

From Autumn meeting of the Dutch Association of Physics; Petten, Netherlands (19 Oct 1984).

Published in summary form only.

32670 (ITF—83-98-R) **Dependence of three-nucleon low-energetic parameters on the number of considering in p-matrix egien states of six-quark bag.** Petrov, N.M.; Pushkash, A.M. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1983. 18p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85701019.

The dependence of two- and three-nucleon low-energy parameters on the choice of P-matrix approximation is investigated using the NN-interaction simple model. The account of pole components in P-matrix which correspond to six-quark states results in the triton binding energy essential decrease and increase in doublet nd-scattering length.

32671 (JINR—R-4-84-15) **Description of (^{7}Li, ^{7}Be) charge-exchange reactions within the framework of microscopic DWBA.** Bang, E.; Gareev, F.A.; Kazacha, G.S.; Goncharov, S.A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1984. 13p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85701020.

The formalism of the (^{7}Li, ^{7}Be) charge-exchange reaction description is based on microscopic distored wave Born approximation is presented. Only the central effective NN-interaction components are considered. The transition densities for ^{7}Li-^{7}Be are calculated in two models: the one-particle shell model and the cluster one. In the latter the recoil effect is taken into account exactly. The formalism is tested with calculations of the form factors and differential cross sections on (^{7}Li, ^{7}Be) reactions in ^{6}Li and ^{40}Ca target-nuclei.

32672 (JINR—R-4-84-135) **Description of Elambda - transitions taking into account of phonon components in wave functions of odd deformed nuclei.** Bastrukov, S.I.; Nesterenko, V.O. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1984. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85701016.

An expression of reduced probability of electrical transitions in deformed odd-A nuclei is obtained within the quasiparticle-phonon model. The commutation relations between quasiparticle and phonon operators, taking into account the quasiparticle structure of phonons, are used. It is shown that corrections arising in such approach can result in a significant change in the reduced probability value (1.5-2 times).

32673 (LA-UR—85-1450) **Polarization transfer in inelastic scattering and pionic models of the EMC effect.** Moss, J.M. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 13p. (CONF-850315—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE85010738.

From Conference on antinucleon and nucleon-nucleus interactions; Telluride, CO, USA (18 Mar 1985).

At the 1982 Telluride Conference Magda Ericson spoke about the interest in a measurement of the σ vector . q vector or spin-longitudinal nuclear response function. It inspired our collaboration to propose a LAMPF experiment, which was subsequently approved, and run in September 1983. In the intervening time the interest has increased dramatically in connection with the European Muon Collaboration (EMC) effect, and the exciting possibility that this ultra high-energy physics result may have to do with nuclear pions - and, hence, the isovector σ vector . q vector nuclear response function. In this talk I will give a brief introduction to the EMC effect and its interpretation in terms of excess nuclear pions. This model establishes a connection between the vastly different scales of the EMC experiment (~ 200 GeV deep-inelastic muon scattering) and the Los Alamos experiment (500 MeV polarized-proton quasifree scattering). Following this I will describe the Los Alamos experiment and its interpretation in terms of excess nuclear pions. Finally I will indulge in some speculation about quark effects in nuclei based on the EMC and Los Alamos experimental results. 29 refs.

32674 (LYCEN—8409) **Pion nucleon-nucleon system in a three-body model with heavy meson exchanges. Application to: πd-πd, πd-NN and NN-NN at intermediate energies.** Perrot, J.L. (Lyon-1 Univ., 69 - Villeurbanne (France). Inst. de Physique Nucleaire; Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires). 1984. 87p. (In French). NTIS (US Sales Only), PC A05/MF A01. File Number DE85751336.

An extension of the three-body Faddeev-Lovelace equations proposed by Avishai and Mizutani in order to take into account the pion absorption in the pion-nucleon-nucleon (xNN) system has been used to describe simultaneously the xd <--> xd, xd <--> NN and NN <--> NN reactions at intermediate energies. The main aspect of this work concerns the introduction of heavy mesons (HM) exchanges. The effect of HM exchange is investigated at first in NN elastic scattering bove the pion production threshold, and then in the xd <--> NN reaction and xd elastic scattering. An extensive comparison between theory and experiments is done for these three reactions in the energy range of the Δ_{33} resonance.

32675 (NAC-AR—84-01, pp 164-166) **Report of the Van de Graaff Group: nuclear reactions and nuclear structure. Polarization in n-p and n-d scattering at 16,9 and 21,6 MeV.** Simpson, B.R.S.; Brooks, F.D. (Cape Town Univ. (South Africa)); Jones, D.T.L. (Cape Provincial Administration). 1984. NTIS (US Sales Only), PC A14/MF A01. File Number DE85780939.

Short note.

In Annual report June 1984. [Council for Scientific and Industrial Research, Faure (South Africa). National Accelerator Center].

32676 (NAC-AR—84-01, pp 163-164) **Report of the Van de Graaff Group: nuclear reactions and nuclear structure. Photodisintegration of the deuteron near threshold.** Smit, F.D.; Brooks, F.D. (Cape Town Univ. (South Africa)); Mingay, D.W.; Stadler, E. (Nuclear Development Corp. of South Africa (Pty.) Ltd., Pelindaba, Pretoria). 1984. NTIS (US Sales Only), PC A14/MF A01. File Number DE85780939.

Short note.

In Annual report June 1984. [Council for Scientific and Industrial Research, Faure (South Africa). National Accelerator Center].

32677 (NAC-AR—84-01, pp 240) **Report of the Research Group. Analyzing-power measurements on quasi-free (p,pα) knockout from ^{9}Be at 150MeV.** Nadasen, A. (University of Michigan, Dearborn); Roos, P.G.; Wang, C.W. (University of Maryland). 1984. NTIS (US Sales Only), PC A14/MF A01. File Number DE85780939.

Short note.

In Annual report June 1984. [Council for Scientific and Industrial Research, Faure (South Africa). National Accelerator Center].

32678 **Mechanism of ^{3}He(π^{-},pn) reaction.** Lee, T.H. (Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review* [*Section*] *C: Nuclear Physics;* **31**: No. 6, 2163-2167(Jun 1985). Contract W-31-109-ENG-38.

The π^{-} absorption by ^{3}He is investigated in a model study based on the nucleon pole mechanism $\pi NN \rightarrow NN \rightarrow NN$. We find that the amplitude of the three-body rescattering mechanism can have a strong interference effect with the amplitude of the direct two-body absorption process even in the region where the two-body process dominates. The main experimental signature of this important coherent effect is a sharp peak near the high energy end of the proton spectrum measured in a coincident experiment. Our results suggest that in order to extract the isospin dependence of pion absorption by a pair of nucleons from the recent ^{3}He(π^{+-},NN) data, the three-nucleon rescattering amplitude must be calculated accurately and included coherently in the analysis.

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32679 (DOE/ER/40048—126) **Determination of the total reaction cross section for heavy ions at 15 MeV/amu, 25 MeV/amu, and 35 MeV/amu.** Loveman, R.A. (Washington Univ., Seattle (USA)). Nov 1984. Contract AC06-81ER40048. 132p. NTIS, PC A07. File Number DE85011445.

The differential elastic cross sections for ^{12}C + ^{12}C and ^{12}C + ^{90}Zr were measured at 15 MeV/amu, 25 MeV/amu, and 35 MeV/amu. The differential cross sections were then fit with standard models to determine the total reaction cross sections at these energies. At energies below 15 MeV/amu the total reaction cross section is geometric. We found neither system could be described by a simple geometric model for these three energies. The total reaction cross sections were compared with calculations made using the optical limit of Glauber theory. These calculations predicted that the total reaction cross section should decrease with increasing energy for the carbon carbon system and should remain constant for the carbon zirconium system. This corresponds to an increase in transparency of about twelve percent over this energy range for both systems. The Glauber model predictions were found to be quite accurate for the carbon system but were completely inconsistent with data for the carbon zirconium system. The predicted values for the total reaction cross section were found to be too small at the low energy and too large at the high energy. The increase in transparency in the carbon zirconium system was twice that of the carbon carbon system. 40 refs.

32680 (GANIL-P—84-11) **First results from GANIL.** Detraz, C. (Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France)). Sep 1984. 14p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85751330.

The aim of the first experiment at GANIL was to examine the variation of the N/Z ratio for projectile like fragments when the incident energy increases. Results presented bring confliding evidences. Some conclusions are drawn. The process pointed to by some of the results shown is examined in detail. The relative velocities of projectile and target at GANIL energies incompass the Fermi velocity. Already a few experiments which use the high energy and high intensity of the beam bring results dealing with the nuclear structure. Then results are reviewed.

32681 (GANIL-P—84-16) **Secondary beams at GANIL.** Langevin, M.; Anne, R. (Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France)). 1984. 19p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85751341.

The LISE facility at the French national heavy ion accelerator GANIL was designed for the production of secondary beams of good optical quality. The first experimental results obtained in atomic physics, radioactive beams production and search for new nuclear species are briefly reported.

32682 (INIS-mf—9299, pp 187-192) **Coincidence measurement of charged pions and forwards emitted light fragments in the reaction of 1 GeV ^{12}C+^{12}C.** Bolore, M.; Charlot, X.; Hisleur, J.M.; Julien, J.; Legrain, R.; Pappalardo, G.S.; Poitou, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physique Nucleaire); Johansson, T. (Uppsala Univ. (Sweden). Gustaf Werner Inst.); Guet, C.; Maurel, M. 1984. NTIS (US Sales Only), PC A10/MF A01. File Number DE85780947. (CONF-840166—).

From 12. international workshop on gross properties of nuclei and nuclear excitations; Hirschegg, Austria (16 Jan 1984).

The authors present preliminary results of an experimental study of the named reactions. (HSI).

32683 (INIS-mf—9632, pp 2) **Study of 1ssub(1/2) and 2ssub(1/2) contributions to the $^{12}C(e,e'p)^{11}B$ (Esub(ex) = 6.79 MeV, Jsup(π) = $1/2^+$) transition.** Steenhoven, G. van der; Blok, H.P.; Herder, J.W.A. den; Jans, E.; Lapikas, L.; Quint, E.N.M.; Witt Huberts, P.K.A. de (Nationaal Inst. voor Kernfysica en Hoge-Energiefysica (NIKHEF), Amsterdam (Netherlands). Sectie K). 19 Oct 1984. NTIS (US Sales Only), PC A02/MF A01. File Number DE85780923. (CONF-8410253—Summ.).

From Autumn meeting of the Dutch Association of Physics; Petten, Netherlands (19 Oct 1984).

Published in summary form only.

32684 (INIS-mf—9632, pp 6) **Resonant absorption of deuteron-capture gamma-rays.** Zijderhand, F.; Kikstra, S.W.; Hanna, S.S.; Leun, C. van der (Rijksuniversiteit Utrecht (Netherlands). Robert van de Graaff Lab.). 19 Oct 1984. NTIS (US Sales Only), PC A02/MF A01. File Number DE85780923. (CONF-8410253—Summ.).

From Autumn meeting of the Dutch Association of Physics; Petten, Netherlands (19 Oct 1984).

Published in summary form only.

32685 (INIS-mf—9632, pp 8) **Elastic scattering of low energy pions.** Prins, T.P.E.; Berkhout, J.B.R.; Elfrink, J. (Vrije Univ., Amsterdam (Netherlands). Natuurkundig Lab.). 19 Oct 1984. NTIS (US Sales Only), PC A02/MF A01. File Number DE85780923. (CONF-8410253—Summ.).

From Autumn meeting of the Dutch Association of Physics; Petten, Netherlands (19 Oct 1984).

Published in summary form only.

32686 (IPNO-DRE—83-35) **Δ in nuclei and spin-isospin excitation.** Roy-Stephan, M. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). 1984. 15p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85751290.

Response function of nuclei to spin-isospin excitation has been studied by (^3He,t) reaction at Saturne Facility. (^3He,t) at intermediate energy is very selective for spin-isospin excitations. Besides Gamow-Teller resonance and other multipolarities spin-isospin resonances, a strong Δ excitation is observed. Two explanations are considered: Δ-hole collective states or quasi free production.

32687 (ISN—84-25) **Inelastic scattering of polarized protons and nuclear deformation in ^{16}O, ^{18}O.** de Swiniarski, R.; Pham, D.L. (Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires). 1984. 9p. (CONF-8406243—1). NTIS (US Sales Only), PC A02/MF A01. File Number DE85751306.

From Europhysics conference on nuclear reactions; Crete, Greece (24 Jun 1984).

Many data concerning inelastic scattering of polarized protons at intermediate energy are now available. We have analyzed some of these data coming from LAMPF at 800 MeV for ^{16}O (6) and ^{18}O (7) in order to further study nuclear deformations for these light nuclei. Analyzing powers (A(theta)) and cross-sections ((σ/theta)) for elastic and inelastic scattering of 800 MeV polarized protons from ^{16}O and ^{18}O have been analyzed in the coupled-channels (CC) collective model using the code ECIS from Raynal.

32688 (JINR—1-83-908) **Comparative analysis of proton and alpha-particle interactions with C, O and Ag, Br nuclei at 4.5 GeV/c per nucleon.** Bogdanov, V.G.; Plyushchev, V.A.; Vokal, S.; Tolstov, K.D.; Shabratova, G.S.; Shumbera, M.; Karabova, M.; Togoo, R. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1983. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85701023.

The comparative analysis of proton and alpha-particle interactions with C, O and Ag, Br nuclei at 4.5 GeV/c per nucleon is carried out. The correct selection of events with free hydrogen among all the inelastic interactions permitted to find the difference between the multiplicity distributions of particles from disintegration of light nuclei and disintegration of heavy ones in their peripheral collisions with nuclei projectiles. It is observed that the increasing of the projectile mass in collisions with target light nuclei leads to the decrease of normalized multiplicities of s-particles, average number of b-particles while the average number of g-particles does not change. Increasing of angular distributions of s- and g-particles is also observed. The comparison of angular distributions of the slowest (b) particles with the calculation of cascade evaporation model shows the applicability of classic evaporation for collisions with Ag, Br nuclei. In the case of C, O nuclei this applicability is questionable.

32689 (KIYI—83-12, pp 11-14) **(p,d) and (p,t) reactions on ^{9}Be at Esub(p)=50 and 72 MEV.** Zaika, N.I.; Mokhnach, A.V.; Rudchik, A.T.; Semenov, V.S.; Shityuk, V.A.; Shmarin, P.L. 1983. (In Russian). NTIS (US Sales Only), PC A03/MF A01. File Number DE85781033.

In Nuclear and physical researches on the isochronous cyclotron U-240 during 1982.

Analysis of differential cross sections of ^{9}Be(p,d)^{8}Be (Esub(sup(8)Be))* 0; 2.94; 16.91; 19.22 MeV) and ^{9}Be(p,t)^{7}Be (Esub(sup(7)Be))* 0; 4.57 MeV) reactions at Esub(p)=50 and 72 MeV is conducted using the method of distorted waves with account of finite-range interaction in the supposition of pickup mechanism. Accountancy of heavy pickup mechanism of ^{7}Li cluster made it possible to improve agreement with differential cross section of ^{9}Be(p,d)^{8}Be reaction at large angles.

32690 **(LA-UR—85-1961) R-matrix analysis of the ^{7}Li system with peripheral channel overlap exchange effects.** Hale, G.M. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 5p. (CONF-850507—18). NTIS, PC A02/MF A01; GPO Dep. File Number DE85012751.

From International conference on nuclear data for basic and applied science; Santa Fe, NM, USA (13 May 1985).

The parameters of an R-matrix analysis that includes data for all reactions open in the ^{7}Li system at E/sub x/ ≦ 10 MeV suggest that deuteron exchange contributes to the low-energy ^{6}Li(n,t) reaction. A method for including this mechanism directly in the theory is discussed and preliminary results are given.

32691 **(LBL—18944) Gamma-ray production cross sections for alpha-particle induced reactions on ^{19}F and ^{23}Na.** Norman, E.B.; Lesko, K.T.; Chupp, T.E.; Schwalbach, P.; De Faccio, M.A. (Lawrence Berkeley Lab., CA (USA); Washington Univ., Seattle (USA). Nuclear Physics Lab.). May 1985. Contract AC03-76SF00098. 6p. (CONF-850507—16). NTIS, PC A02/MF A01; GPO Dep. File Number DE85012603.

From International conference on nuclear data for basic and applied science; Santa Fe, NM, USA (13 May 1985).

Production cross sections have been measured for γ-ray lines excited in α-particle bombardments of a NaF target for beam energies from 4.5 to 26 MeV.

32692 **Measurement of the ^{16}N(2^{-},g.s.)→ ^{16}O(0 $^{+}$,g.s.)+e^{-} +nu-bar/sub e/ beta-decay branching ratio.** Heath, A.R.; Garvey, G.T. (Argonne National Laboratory, Argonne, Illinois 60439 and University of Chicago, Chicago, Illinois 60637). *Physical Review [Section] C: Nuclear Physics;* **31**: No. 6, 2190-2198(Jun 1985). Contract W-31-109-ENG-38.

The ^{16}N(2^{-},g.s.)→ ^{16}O(0 $^{+}$,g.s.)+e^{-} +nu-bar/sub e/ branching ratio is remeasured. A flatfield magnetic spectrometer, instrumented with a multiwire position-sensitive proportional detector, is used. A value for the branching ratio Γ/sub β/(2^{-}→0^{+})/Γ/sub β/(2^{-}) = 0.2811 +- 0.0064 is determined. Combining this result with another recent determination produces a best value for this branching ratio. This in turn allows a more precise determination of the beta-decay rate (Λ/sub β/) for the process ^{16}N(0^{-}, 120 keV)→ ^{16}O(0^{+},g.s.)+e^{-} +nu-bar/sub e/. A value Λ/sub β/(0^{-}→0^{+}) = 0.489 +- 0. 020 sec^{-1} is obtained, which agrees with calculation only when pion exchange currents are included in the nucleon axial current.

32693 **E2 strength of the lowest resonance in ^{6}Li(α,γ): Collective effects in the 1p shell.** Nelson, J.E.; Napolitano, J.; Freedman, S.J. (Physics Division, Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review [Section] C: Nuclear Physics;* **31**: No. 6, 2295-2296(Jun 1985). Contract W-31-109-ENG-38.

We have measured the ratio of resonance strengths for alpha capture on ^{6}Li to the 4.77- and 5.16-MeV states of ^{10}B. We find ωγ(4.77)/ωγ(5.16) = 0.102 +- 0.004. When combined with the accepted value for ωγ(5.16) we determine the E2 strength of the 4.77- to 0.72-MeV level transition in ^{10}B to be B(E2) = 21 +- 2 e^{2}fm^{4}, in agreement with a previous measurement when center-of-mass corrections are properly taken into account. The agreement between our result and Kurath's interpretive model for ^{10}B improves when collective effects in the 1p shell are included.

32694 **Subthreshold pion production: An intranuclear N-N collision interpretation.** Blann, M. (Lawrence Livermore National Laboratory, University of California, Livermore, California 94550). *Physical Review Letters;* **54**: No. 20, 2215-2217(20 May 1985). Contract W-7405-ENG-48.

π^{0} production cross sections are calculated with use of a Boltzmann master equation which assumes a nucleon-nucleon collision relaxation mechanism for the reaction of 35 MeV/nucleon ^{14}N with ^{27}Al, ^{58}Ni, and ^{184}W targets, and for ^{12}C+ ^{12}C at energies of 60, 74, and 84 MeV/nucleon. Results support a nucleon-nucleon collision mechanism as one possible interpretation of experimental yields.

6514 Nuclear Properties And Reactions, A=20-38

REFER ALSO TO CITATION(S) 32694, 32700, 32791

32695 **(CEA-CONF—7403) Fragmentation processes in nuclear reactions.** Legrain, R. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Aug 1984. 42p. (CONF-8408148—1; DPh-N-S—2195). NTIS (US Sales Only), PC A03/MF A01. File Number DE85751335.

From International school of atomic and nuclear heavy ion interactions; Poiana Brasov, Romania (28 Aug 1984).

Projectile and nuclear fragmentation are defined and processes referred to are recalled. The two different aspects of fragmentation are considered but the emphasis is also put on heavy ion induced reactions. The preliminary results of an experiment performed at GANIL to study peripheral heavy ions induced reactions at intermediate energy are presented. The results of this experiment will illustrate the characteristics of projectile fragmentation and this will also give the opportunity to study projectile fragmentation in the transition region. Then nuclear fragmentation is considered which is associated with more central collisions in the case of heavy ion induced reactions. This aspect of fragmentation is also illustrated with two heavy ion experiments in which fragments emitted at large angle have been observed.

32696 (INIS-mf—9299, pp 193-195) **Mean field approach to pion production in intermediate energy heavy ion collisions.** Tohyama, M.; Kaps, R.; Masak, D.; Mosel, U. (Giessen Univ. (Germany, F.R.). Inst. fuer Theoretische Physik). 1984. NTIS (US Sales Only), PC A10/MF A01. File Number DE85780947. (CONF-840166—).

From 12. international workshop on gross properties of nuclei and nuclear excitations; Hirschegg, Austria (16 Jan 1984).

In the present paper we report results of calculations in the slab geometry that contains essential features of head-on collisions. (orig./HSI).

32697 (INIS-mf—9299, pp 1-7) **Collective flow of nuclear matter.** Ritter, H.G.; Gustafsson, H.A.; Gutbrod, H.H.; Kolb, B.; Loehner, H.; Ludewigt, B.; Poskanzer, A.M.; Renner, T.; Riedesel, H.; Warwick, A. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Lawrence Berkeley Lab., CA (USA)). 1984. NTIS (US Sales Only), PC A10/MF A01. File Number DE85780947. (CONF-840166—).

From 12. international workshop on gross properties of nuclei and nuclear excitations; Hirschegg, Austria (16 Jan 1984).

The reactions Ca+Ca and Nb+Nb at 400 MeV/nucleon have been studied at the Bevalac using the Plastic Ball spectrometer. A global analysis of the events shows two nontrivial collective flow effects: 1) The projectile fragments are found slightly displaced from the beam axis (bounce-off). 2) The intermediate rapidity fragments have a preference for emission angles of 20 to 30 degrees in the center of mass system (side-splash) for the higher multiplicity events of Nb+Nb which is not so evident for Ca+Ca. Neither effect is seen in a knock-on cascade calculation. A simulation with an event generating statistical model has been done in order to extract the magnitude of the effects. (orig.).

32698 (INIS-mf—9632, pp 1) **Contribution of 2(h/2π)ω transitions to the excitation of 0^+ states in ^{58}Ni and ^{26}Mg in inelastic electron scattering.** Blok, H.; Blok, H.P.; Hienen, J.F.A. van; Steenhoven, G. van der (Vrije Univ., Amsterdam (Netherlands)); Vries, H. de (Nationaal Inst. voor Kernfysica en Hoge-Energiefysica (NIKHEF), Amsterdam (Netherlands). Sectie K). 19 Oct 1984. NTIS (US Sales Only), PC A02/MF A01. File Number DE85780923. (CONF-8410253—Summ.).

From Autumn meeting of the Dutch Association of Physics; Petten, Netherlands (19 Oct 1984).

Published in summary form only.

32699 (ISN—84-26) **Parity non-conservation in the radiative capture of polarized neutrons by ^{35}Cl.** Avenier, M.; Bagieu, G.; Benkoula, H.; Cavaignac, J.F.; Idrissi, A.; Koang, D.H.; Vignon, B.; Wilson, R. (Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires). Apr 1984. 18p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85751294.

We report a measurement of the forward-backward asymmetry in the radiative capture of polarized cold neutrons in the reaction ^{35}Cl(n,γ)^{36}Cl where ^{36}Cl is in the ground state. The measured value of the asymmetry is a = (1.57 +- 0,531 10^{-4}. We deduce the mixing between the 2^+ capture level and the neighboring 2^- level to be <2^-/Hsub(pv)/ 2^+ > = - (0.25 +- 0.08) eV before corrections. A measurement of the integral asymmetry of all gamma rays in the neutron capture by ^{35}Cl leads to agreement with measurements at Leningrad.

32700 (LYCEN—8349) **Study of the light particle emission in the transition region of mechanisms on SARA.** Guinet, D. (Lyon-1 Univ., 69 - Villeurbanne (France). Inst. de Physique Nucleaire; Lyon-1 Univ., 69 - Villeurbanne (France)). 1984. 85p. (In French). NTIS (US Sales Only), PC A05/MF A01. File Number DE85751293.

The results of one of the first experiments on SARA are given. ^{14}N+^{27}Al reaction with a 420 MeV Nitrogen beams has been studied. The experimantal techniques, peculiarly a simple study of the CSI (Na) and BGO crystals, are reported. Then the experimental results are presented, reaction mechanism are described and analyzed. We try to fit the fragmentation process with the Goldhaber and Friedman models. the isotope production for Z=1, 2 is analyzed in the frame of the coalescence model and of the hot liquid nuclear matter drop model. Our exclusive measurements bring some new informations about the different mechanisms origin. To conclude, a code coupling reaction dynamics and preequilibrium emission is described and results are compared with the experimental data.

6515 Nuclear Properties And Reactions, A=39-58

32701 (IAE—3790/2) **Project of an experiment on search for the neutrinoless double beta decay of ^{48}Ca.** Bakalyarov, A.M.; Balysh, A.Ya.; Kondratenko, I.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1983. 55p. (In Russian). NTIS (US Sales Only), PC A04/MF A01. File Number DE85701024.

A study is made on possibilities of experimental search for the neutrinoless double beta decay. The up-to-date theoretical aspects of the problem, different mechanisms of 2β(0ν)-decay, matrix element values are discussed. The experiment flow sheet is suggested, the expected backgrounds of the device are calculated. It is shown that the use of $\beta 4^{8}$Ca isotope in amounts of 10g may increase the experimental limit with respect to half-decay period up to Tsub(1/2) >= 2x10^{22} years, which corresponds to the upper limit for msub(ν) <= 20 eV Majorana mass of electron neutrino.

32702 (INIS-mf—9299, pp 34-44) **Participant region radii from 4 π detection of proton-proton correlations in relativistic heavy ion reactions.** Wieman, H.; Gustafsson, H.A.; Gutbrod, H.H.; Kolb, B.; Loehner, H.; Ludewigt, B.; Poskanzer, A.M.; Renner, T.; Riedesel, H.; Ritter, H.G. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); California Univ., Berkeley (USA). Div. of Nuclear Science). 1984. NTIS (US Sales Only), PC A10/MF A01. File Number DE85780947. (CONF-840166—).

From 12. international workshop on gross properties of nuclei and nuclear excitations; Hirschegg, Austria (16 Jan 1984).

We report here source radii as a function of event charge multiplicity for two different reactions; ^{40}Ca on Ca and ^{93}Nb on ^{93}Nb both at 400 MeV/nucleon. In both cases the radii are well fit with the same cube root dependence on charge particle multiplicity. The proton-proton correlations used in this study were measured at the Bevalac with the plastic ball detector, a device with several features that are particularly useful in this application. (orig./HSI).

32703 (IPNO-DRE—83-21) **Excitation of ΔL=0 spin-flip transitions in the N=28 isotones by 201 MeV proton inelastic scattering.** Djalali, C.; Marty, N.; Morlet, M.; Willis, A.; Jourdain, J.C.; Anantaraman, N.; Crawley, G.M.; Galonsky, A.; Duffy, J. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). 1983. 32p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85751328.

The excitation of 1^+ states by inelastic scattering of 201 MeV protons studied previously on the N=28 nuclei ^{48}Ca and ^{51}V, has been pursued on ^{50}Ti, ^{52}Cr and ^{54}Fe; for the three latter nuclei many sharp states are observed which have a very forward peaked angular distribution characteristic of a ΔL=0 transition. The results agree reasonably well with (e,e') measurements. A comparison with (γ vector, γ) results demonstrated the 1^+ nature of these states. The data are compared with DWIA calculations performed using the shell model wave functions of Metsch and Knuepfer. This comparison indicates that the isoscalar excitations are probably weaker than predicted. The ratio of experimental to predicted cross sections ranges from 0.25 for ^{50}Ti to 0.44 for ^{54}Fe.

32704 (ISN—84-27) **Elastic scattering of polarized deuteron at intermediate energies.** Nguyen Van Sen; Arvieux, J.; Bruge, G. (Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires). 1984. 2p. (CONF-840789—9-Summ.). NTIS (US Sales Only), PC A02/MF A01. File Number DE85751305.

From International conference on particles and nuclei; Heidelberg, F.R. Germany (30 Jul 1984).

Published in summary form only.

32705 (NAC-AR—84-01, pp 169) **Report of the Van de Graaff Group: nuclear reactions and nuclear structure. The level structure, gamma-ray branching and mean lifetimes of states in ^{43}Sc, ^{43}K and ^{55}Mn.** Froneman, S.; Olivier, L.D.; Janse van Rensburg, M.P.; Naude, W.J.; Koen, J.W. (Stellenbosch Univ. (South Africa)). 1984. NTIS (US Sales Only), PC A14/MF A01. File Number DE85780939.

Short note.

In Annual report June 1984. [Council for Scientific and Industrial Research, Faure (South Africa). National Accelerator Center].

32706 (NAC-AR—84-01, pp 171-172) **Report of the Van de Graaff Group: nuclear reactions and nuclear structure. Spins of excited states in ^{43}Sc, ^{43}K and the mechanism of$^{48'50}$Ti(p,p$'$,γ)$^{48'50}$Ti and $^{40'50}$Ti(α,$\alpha'\gamma$)$^{48'50}$Ti reactions at Ep = 6 MeV and Eα = 12 MeV.** Froneman, S.; Olivier, L.D.; Van Waart, J.; Naude, W.J.; Koen, J.W. (Stellenbosch Univ. (South Africa)). 1984. NTIS (US Sales Only), PC A14/MF A01. File Number DE85780939.

Short note.

In Annual report June 1984. [Council for Scientific and Industrial Research, Faure (South Africa). National Accelerator Center].

32707 (NAC-AR—84-01, pp 169-170) **Report of the Van de Graaff Group: nuclear reactions and nuclear structure. Angular correlation measurements with (α,pγ) reactions.** Froneman, S.; Van der Merwe, M.G.; Naude, W.J.; Stander, J.A.; Richter, W.A. (Stellenbosch Univ. (South Africa)). 1984. NTIS (US Sales Only), PC A14/MF A01. File Number DE85780939.

Short note.

In Annual report June 1984. [Council for Scientific and Industrial Research, Faure (South Africa). National Accelerator Center].

6516 Nuclear Properties And Reactions, A=59-89

REFER ALSO TO CITATION(S) 32733

32708 (BNL—36439) **Specificity of ^{71}Ga(p,n)^{71}Ge at 35 MeV for Gamow-Teller strength.** Baltz, A.J.; Weneser, J.; Brown, B.A.; Rapaport, J. (Brookhaven National Lab., Upton, NY (USA); USDOE, Washington, DC; Michigan State Univ., East Lansing (USA); Ohio Univ., Athens (USA)). 1985. Contract AC02-76CH00016. 7p. (CONF-850315—3). NTIS, PC A02/MF A01; GPO Dep. File Number DE85011837.

From Conference on antinucleon and nucleon-nucleus interactions; Telluride, CO, USA (18 Mar 1985).

The motivation for considering the ^{71}Ga(p,n)^{71}Ge reaction is to help determine the properties of ^{71}Ga as a detector of solar neutrinos. The proposed solar neutrino experiment, ^{71}Ga(nu,e$^-$)^{71}Ge, has a threshold of only .236 MeV, and is thus sensitive to neutrinos produced in the basic burning process in the sun p + p → ^{2}H + e$^+$ + nu, which has a .420 MeV endpoint. The excitation of the (5/2)$^-$ state at .175 MeV in ^{71}Ge could be important, however. Were the Gamow-Teller (G-T) transition to the 175 keV state equal in strength to the ground state transition there would be ~ 25% added to the detector signal, the greater part of this coming from the ^{7}Be neutrinos; the desired sensitivity to the p-p neutrinos would then be less.

32709 (CONF-850507—13) **Calculated neutron-induced cross sections for /sup 63,65/Cu /sup 58,60/Ni, and ^{52}Cr from 1 to 20 MeV and comparisons with experiments.** Hetrick, D.M.; Fu, C.Y.; Larson, D.C. (Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 5p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85011928.

From International conference on nuclear data for basic and applied science; Santa Fe, NM, USA (13 May 1985).

Nuclear model codes were used to compute cross sections for neutron-induced reactions on /sup 63,65/Cu, /sup 58,60/Ni, and ^{52}Cr for incident energies from 1 to 20 MeV. The input parameters for the model codes determined through analysis of experimental data in this energy region. The models used, the input data, the resulting calculations, and comparisons with measured data are discussed. 15 refs.

32710 (GANIL-P—84-13) **Heavy fragments emission in the ^{84}Kr on ^{12}C reaction at 35 MeV/nucleon.** Mittig, W.; Cunsolo, A.; Foti, A.; Wieleczko, J.P.; Auger, F.; Berthier, B.; Pascaud, J.M.; Quebert, J.; Plagnol, E. (Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France)). 1984. 13p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85751340.

Heavy residues of collisions of ^{84}Kr + ^{12}C at 35 MeV/amu were measured using time of flight ΔE-E telescopes. An important part of the total cross-section leads to events that have all the characteristics of an equilibrated composite system decaying by heavy fragments emission. The experimental yields are well reproduced using a statistical model.

32711 (NAC-AR—84-01, pp 154-158) **Report of the Van de Graaff Group: nuclear reactions and nuclear structure. Neutron cross sections of ^{89}Y analysed in terms of the level structure and reaction mechanisms.** McMurray, W.R.; Renan, M.J.; Van Heerden, I.J. (University of the Western Cape, Bellville (South Africa)); Budtz-Jorgensen, C. (Geel, Belgium); Guenther, P.T.; Smith, A.B.; Whalen, J.F. (Argonne National Laboratory, USA). 1984. NTIS (US Sales Only), PC A14/MF A01. File Number DE85780939.

In Annual report June 1984. [Council for Scientific and Industrial Research, Faure (South Africa). National Accelerator Center].

Despite extensive charged-particle studies the level structure of Yttrium 89 above 3 MeV was essentially unknown and uncertainties remained at lower excitations. In the study total cross section measurements were made at incident neutron energies of 0,5 x 0,1 to 4,2 MeV. Differential neutron scattering measurements were made at 50 keV intervals from 1,5 to 4,0 MeV. Differential inelastic cross sections were determined concurrently with the elastic scattering cross sections. Inelastic gamma ray measurements were also made.

32712 (NAC-AR—84-01, pp 162-163) **Report of the Van de Graaff Group: nuclear reactions and nuclear structure. Studies involving (n,p) and (n,d) reactions.** McMurray, W.R.; Bharuth-Ram, K.; Gafoor, F. (Durban-Westville Univ. (South Africa)). 1984. NTIS (US Sales Only), PC A14/MF A01. File Number DE85780939.

Short note.

In Annual report June 1984. [Council for Scientific and Industrial Research, Faure (South Africa). National Accelerator Center].

32713 **LBL/UCSB Ge-76 double beta decay experiment - first results.** Goulding, F.S.; Cork, C.P. (Univ. of California, Berkeley). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-32**: 463-470(Feb 1985). Contract AC03-76SF00098.

Preliminary results of an experimental effort to detect the neutrinoless double-beta decay of Ge-76 are presented. The experimental apparatus, including eight 150-cu cm Ge detectors (total Ge mass 6.4 kg), 6-inch-thick NaI Compton shielding, OFHC copper enclosures and mountings, and electronics permitting unattended operation over long periods, is described in detail. The physical principles involved are reviewed; and the performance of the system in an above-ground laboratory using only one or four detectors is characterized and illustrated with graphs. A half-life limit of 4 x 10 to the 22nd yr at confidence level 68 percent is established for the double-beta decay on the basis of 1620 h of operation. The background in the range of interest (around 2.041 MeV) is estimated as 5 x 10 to the -6th counts/h keV cu cm (comparable to the 2 x 10 to the -6th counts/h keV cu cm typically reported for deep-underground facilities) and attributed mainly to prompt gamma rays from cosmic-ray-induced neutrons.

32714 **Analyzing power for the inelastic continuum with 200 MeV protons.** Lisantti, J.; Tinsley, J.R.; McDaniels, D.K. (Oregon Univ., Eugene (USA)); Drake, D.M. (Los Alamos National Lab., NM (USA)); Bergqvist, I. (Lund Univ. (Sweden)); Swenson, L.W. (Oregon State Univ., Corvallis (USA)); Bertrand, F.E.; Gross, E.E.; Horen, D.J.; Sjoreen, T.P. (Oak Ridge National Lab., TN (USA)). *Physics Letters, [Section] B;* **147**: No. 1-3, 23-26(1 Nov 1984).

Inelastic proton scattering from targets of ^{60}Ni, ^{90}Zr, and ^{208}Pb has been studied using 200-MeV polarized and unpolarized protons. The behavior with angle of a narrow region at the peak of the continuum underneath the giant resonance spectra follows that expected for free nucleon-nucleon scattering, modified by an energy shift dependent on target mass. Analyzing power results support the hypothesis that single-step quasifree scattering represents a significant fraction of the overall inelastic scattering for the excitation region near the proposed quasifree peak, but indicate that other processes start to dominate above this excitation region.

32715 **High spin spectrometry of light zirconium isotopes sup(82-90)Zr.** Lister, C.J.; Varley, B.J. (Manchester Univ. (UK). Dept. of Physics); Price, H.G. (Daresbury Lab. (UK)); Warburton, E.K.; Olness, J.W. (Brookhaven National Lab., Upton, NY (USA)); Becker, J.A. (Lawrence Livermore National Lab., CA (USA)). pp 39-49 of Proceedings of the International symposium on in-beam nuclear spectroscopy held at Debrecen, Hungary, 14-18 May 1984. Dombradi, Zs.; Fenyes, T. (eds.). Budapest, Hungary; Akademiai Kiado (1984). (CONF-840530—).

From International symposium on in-beam nuclear spectroscopy; Debrecen, Hungary (14 May 1984).

Extensive spectroscopic studies were made on high spin states in the light zirconium isotopes sup(82-90)Zr. Measurements include $\sigma(E)$, W(theta), P(90), Γ via RDM and DSAM, γ-γ-Γ, n-γ-γ, n-n-γ coincidences and investigation of βsup(+) decay from odd-odd Nb nuclei. Spherical and deformed shell model calculations were performed to facilitate the interpretation of these data. The competition between collective and intrinsic excitation was examined both as a function of neutron number and total angular momentum.

6517 Nuclear Properties And Reactions, A=90-149

32716 **(CBPF-NF—020/83) States in ^{118}Sn from ^{117}Sn(d,p) ^{118}Sn at 12 MeV.** Frota-Pessoa, E. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1983. 33p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85701448.

^{118}Sn energy levels up to = 5.2 MeV excitation energy are studied in the reaction ^{117}Sn (d,p) ^{118}Sn. Deuterons had a bombarding energy of 12 MeV. The protons were analyzed by a magnetic spectrograph. The detector was nuclear emulsion and the resolution in energy about 10 KeV. The distorted-wave analysis was used to determine l values and spectroscopic strengths. Centers of gravity and the sums of reduced spectroscopic factors are presented for the levels when it was possible to determine the S' value. 66 levels of excitation energy were found which did not appear in previous ^{117}Sn (d,p) reactions. 40 levels were not found previously in any reaction giving ^{118}Sn. The results are compared with the known ones.

32717 **(CONF-850507—15) Fast-neutron interaction with niobium.** Smith, A.B.; Guenther, P.T.; Poenitz, W.P.; Smith, D.L.; Whalen, J.F.; Howerton, R.J. (Argonne National Lab., IL (USA); Lawrence Livermore National Lab., CA (USA)). 1985. Contract W-31-109-ENG-38. 5p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85011471.

From International conference on nuclear data for basic and applied science; Santa Fe, NM, USA (13 May 1985).

Results of a comprehensive study of the interaction of fast neutrons with niobium are presented, including measurement and interpretation of neutron total, differential-scattering and radiative-capture cross sections. The experimental results are interpreted in the context of the optical-statistical model, with attention to the Fermi-surface anomaly. Experimental results, physical interpretations and rigorous statistical methods are used to provide a comprehensive evaluated nuclear data file suitable for use in a wide range of applied neutronic calculations.

32718 **(FEI—1385) Measurement and analysis of neutron emission spectrum under niobium nucleus bombardment by 14 MeV neutrons.** Lychagin, A.A.; Vinogradov, V.A.; Grudzevich, O.T.; Devkin, B.V.; Kotel'nikova, G.V.; Plyaskin, V.I.; Sal'nikov, O.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1983. 16p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85701025.

Spectra of inelastically scattered neutrons on niobium nuclei at 30, 45, 60, 75, 90, 120 and 135 deg angles were measured for 14.3 MeV neutron initial energy. The integral energy spectrum of neutron emission was obtained. Theoretical analysis of obtained spectrum was made. Spectra of the first and the second neutrons were separated out of the total spectrum and the (n, 2n) reaction cross-section was calculated.

32719 (INIS-mf—9299, pp 17-22) **Aspects of hydrodynamical flow in view of recent high and intermediate energy heavy ion data.** Buchwald, G.; Graebner, G.; Rentzsch, T.; Maruhn, J.A.; Stoecker, H.; Greiner, W. (Frankfurt Univ. (Germany, F.R.). Inst. fuer Theoretische Physik). 1984. NTIS (US Sales Only), PC A10/MF A01. File Number DE85780947. (CONF-840166—).

From 12. international workshop on gross properties of nuclei and nuclear excitations; Hirschegg, Austria (16 Jan 1984).

We compare the results of our hydrodynamic calculations with recent ^{93}Nb+^{93}Nb (Esub(lab)=400 MeV/n) data from the GSI-LBL Plastic Ball Group and with the Ar+Pb (Esub(lab)=800 MeV/n) data from the streamer chamber measurements by the GSI-LBL Heidelberg collaboration. (orig./HSI).

32720 (INIS-mf—9299, pp 53-62) **Multifragment production in high-energy proton nucleus collisions.** Gross, D.H.E. (Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (Germany, F.R.). Bereich Kern- und Strahlenphysik; Freie Univ. Berlin (Germany, F.R.). Fachbereich Physik). 1984. NTIS (US Sales Only), PC A10/MF A01. File Number DE85780947. (CONF-840166—).

From 12. international workshop on gross properties of nuclei and nuclear excitations; Hirschegg, Austria (16 Jan 1984).

The decay of the target nucleus after bombardment with protons with energy above several GeV is calculated in the frame of a statistical model. The phase-space of decay channels (partition sum) is calculated realistically by taking the finiteness of the system and the strong Coulomb interaction between the fragments into account. Under such conditions the system behaves quite differently from neutral macro systems near the gas-liquid phase transition. The mass-yield of the fragments is U-shaped and consistent with experiments in the entire fragment-mass range. Characteristic 'phase transitions' are found. (orig.).

32721 (INIS-mf—9299, pp 64-66) **Short-range and long-range correlations in the p-Xe scattering at 200 GeV.** Derado, I. (Max-Planck-Institut fuer Physik und Astrophysik, Muenchen (Germany, F.R.)). 1984. NTIS (US Sales Only), PC A10/MF A01. File Number DE85780947. (CONF-840166—).

From 12. international workshop on gross properties of nuclei and nuclear excitations; Hirschegg, Austria (16 Jan 1984).

We observed short-range correlations, the strength of which depends on the number of independent interactions inside the nucleus. We observed long-range correlations in a hadron nucleus interaction for the first time. The long-range correlations, as opposed to short-range correlations, increase with the number of interactions of the projectile inside the nucleus. (orig./HSI).

32722 (INIS-mf—9632, pp 5) **1983 Atomic Mass Table and beyond.** Wapstra, A.H. (Nationaal Inst. voor Kernfysica en Hoge-Energiefysica (NIKHEF), Amsterdam (Netherlands). Sectie K). 19 Oct 1984. NTIS (US Sales Only), PC A02/MF A01. File Number DE85780923. (CONF-8410253—Summ.).

From Autumn meeting of the Dutch Association of Physics; Petten, Netherlands (19 Oct 1984).

Published in summary form only.

32723 (INIS-mf—9632, pp 1) **Fragmentation of stretched spin states in ^{116}Sn.** Werf, S.Y. van der; Blasi, N.; Harakeh, M.N. (Rijksuniversiteit Groningen (Netherlands). Kernfysisch Versneller Inst.); Waroquier, M. (Ghent Rijksuniversiteit (Belgium)). 19 Oct 1984. NTIS (US Sales Only), PC A02/MF A01. File Number DE85780923. (CONF-8410253—Summ.).

From Autumn meeting of the Dutch Association of Physics; Petten, Netherlands (19 Oct 1984).

Published in summary form only.

32724 (INIS-mf—9632, pp 2) **Study of hole states in ^{90}Zr by the (e,e'p) reaction.** Herder, J.W.A. den; Jans, E.; Keizer, P.H.M.; Lapikas, L.; Quint, E.N.M.; Witt Huberts, P.K.A. de (Nationaal Inst. voor Kernfysica en Hoge-Energiefysica (NIKHEF), Amsterdam (Netherlands). Sectie K); Blok, H.P.; Steenhoven, G. van der (Vrije Univ., Amsterdam (Netherlands)). 19 Oct 1984. NTIS (US Sales Only), PC A02/MF A01. File Number DE85780923. (CONF-8410253—Summ.).

From Autumn meeting of the Dutch Association of Physics; Petten, Netherlands (19 Oct 1984).

Published in summary form only.

32725 (INIS-mf—9632, pp 4) **E0 transitions in light fission fragments.** Klinken, J. van; Hamill, J.J.; Verhoeven, A.J.; Venema, W.Z.; Wichers, V.A. (Rijksuniversiteit Groningen (Netherlands). Kernfysisch Versneller Inst.). 19 Oct 1984. NTIS (US Sales Only), PC A02/MF A01. File Number DE85780923. (CONF-8410253—Summ.).

From Autumn meeting of the Dutch Association of Physics; Petten, Netherlands (19 Oct 1984).

Published in summary form only.

32726 (INIS-mf—9632, pp 5) **Accurate mass determination of neutron deficient indium nuclei.** Bom, V.R.; Coops, P.C.; Hollander, R.W. (Technische Hogeschool Delft (Netherlands)); Coenen, E.; Deneffe, K.; VanDuppen, P.; Huyse, M. (Louvain Univ. (Belgium)). 19 Oct 1984. NTIS (US Sales Only), PC A02/MF A01. File Number DE85780923. (CONF-8410253—Summ.).

From Autumn meeting of the Dutch Association of Physics; Petten, Netherlands (19 Oct 1984).

Published in summary form only.

32727 (INIS-mf—9632, pp 1) **Coexistence of spherical and deformed states in neutron deficient Pb isotopes.** Penninga, J.; Hesselink, W.H.A.; Stolk, A.; Verheul, H. (Vrije Univ., Amsterdam (Netherlands). Natuurkundig Lab.); Riezebos, H.; Voigt, M.J.A. de; Zemel, A. (Rijksuniversiteit Groningen (Netherlands). Kernfysisch Versneller Inst.). 19 Oct 1984. NTIS (US Sales Only), PC A02/MF A01. File Number DE85780923. (CONF-8410253—Summ.).

From Autumn meeting of the Dutch Association of Physics; Petten, Netherlands (19 Oct 1984).

Published in summary form only.

32728 **(ISN—84-22) Difference of the dynamic moment of inertia Isub(band)sup(2)) for Xe and Ba nuclei.** Barci, V.; El-Saman, H.; Bengtsson, T. (Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires). 1984. 1p. (CONF-8403127—6-Summ.). NTIS (US Sales Only), PC A02/MF A01. File Number DE85751307.

From 5. Nordic meeting on nuclear physics; Jyvaskyla, Finland (12 Mar 1984).

Published in summary form only.

32729 **(ISN—84-23) Dynamic moment of inertia in the Ba-region.** Jerrestam, D.; Elfstroem, S.; Barci, V. (Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires). 1984. 1p. (CONF-8403127—7-Summ.). NTIS (US Sales Only), PC A02/MF A01. File Number DE85751308.

From 5. Nordic meeting on nuclear physics; Jyvaskyla, Finland (12 Mar 1984).

Published in summary form only.

32730 **(JINR—E-1-83-850) Stopping and energy deposition of hadrons in target nuclei.** Strugalski, Z. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1983. 10p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85701026.

In an analysis of pion-xenon nucleus collisions at 2.34-9 GeV/c momentum events are identified in which incident pions were completely stopped and deposited their energy in target nucleus. Probability of appearance of such "stopped" events among any-type pion-xenon collision events depends on the incident pion momentum and is: approximately 0.15 at 2.34 GeV/c, approximately 0.02 at 3.5 GeV/c, and approximately 0 at higher momenta. Formula expressing probability of appearance of the "stopped" events is derived. Range-energy relation in nuclear matter for pions and protons is given.

32731 **(JINR—R-7-84-68) Decay of highly excited compound nuclei: a statistical approach.** Il'inov, A.S.; Cherepanov, E.A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1984. 23p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85701021.

In the framework of a statistical method the experimental data on the decay of moderately excited ($10 < E^{*}$ 200 MeV) nuclei produced in heavy ion fusion reactions are analysed. It is shown that taking into account the damping of shell effects with increasing excitation energy allows one to describe a large amount of data at $E^{*}<200$ MeV energies. The statistical properties, macroscopic "temperature" effects, new mechanisms of nuclear decay at high excitation energies ($E^{*}>200$ MeV) and the possibilities of extending such investigations on complete-fusion reactions induced by low-energy (<20 MeV/nucleon) heavy ions (Asub(i) approximately 50-100) are examined.

32732 (NAC-AR—84-01, pp 159-162) **Report of the Van de Graaff Group: nuclear reactions and nuclear structure. Fast-neutron cross sections of elemental indium; decay scheme of ^{115}In and optical model parameters.** Van Heerden, I.J. (University of the Western Cape, Bellville (South Africa)); McMurray, W.R.; Smith, A.B.; Guenther, P.T.; Whalen, J.F. (Argonne National Laboratory, USA). 1984. NTIS (US Sales Only), PC A14/MF A01. File Number DE85780939.

In Annual report June 1984. [Council for Scientific and Industrial Research, Faure (South Africa). National Accelerator Center].

Elemental indium is 96% ^{115}In which is one gsub(9/2) proton short of the closed shell at N=50. The neutron measurements in this study were confined to the total and elastic scattering cross sections. With its superior resolution and non-selective population of low-lying levels it has been possible to identify at least 35 levels up to an excitation of 2442 keV. Neutron inelastic scattering cross sections for individual states in ^{115}In were obtained from (n,n^{1},γ) measurements. The study has extended the knowledge of the decay scheme and provided a basis for an optical model which quantitatively describes the observations.

32733 **(UCRL—92666) Measurements and calculations of neutron scattering angular distributions over a wide mass and energy range.** Hansen, L.F. (Lawrence Livermore National Lab., CA (USA)). May 1985. Contract W-7405-ENG-48. 13p. (CONF-850507—19). NTIS, PC A02/MF A01; GPO Dep. File Number DE85012912.

From International conference on nuclear data for basic and applied science; Santa Fe, NM, USA (13 May 1985).

Neutron elastic and inelastic differential cross sections for targets between ^{9}Be and ^{239}Pu at energies, $E > 14$ MeV have been measured using the Livermore and Ohio University neutron time-of-flight facilities. We review here the data and the analyses based on two local microscopic optical potentials: that of Jeukenne, Lejeune and Mahaux, and that of Brieva and Rook. The results are also compared with calculations using global potentials. Coupled channel formalism has been used in the analysis of targets with strong deformations, such as Be, C, Ta, and actinides. The value of the microscopic optical potentials as a tool to predict elastic and inelastic neutron cross sections over a wide mass and energy range is discussed. The need for neutron measurements up to higher energies and their analysis in conjunction with (p,p) and charge exchange (p,n) data is addressed. 17 refs.

32734 Rotational structures at A=100. Sistemich, K.; Lhersonneau, G. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.)); Meyer, R.A. (Lawrence Livermore National Lab., CA (USA)); Seo, T. (Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst.). pp 51-57 of Proceedings of the International symposium on in-beam nuclear spectroscopy held at Debrecen, Hungary, 14-18 May 1984. Dombradi, Zs.; Fenyes, T. (eds.). Budapest, Hungary; Akademiai Kiado (1984). (CONF-840530—).

From International symposium on in-beam nuclear spectroscopy; Debrecen, Hungary (14 May 1984).

Rotational bands in the odd-mass isotopes of Sr through Mo with $N > 60$ indicate that these nuclei are good rotors. Experimental values are obtained for Nilsson-model parameters. The moments of inertia are close to the rigid-rotor values.

6518 Nuclear Properties And Reactions, A=150-189

REFER ALSO TO CITATION(S) 32791

32735 (GSI—85-2-Prepr.) Feeding times of high spin states in sup(152,154)Dy: Probes of nuclear structure above the yrast line. Azgui, F.; Emling, H.; Grosse, E.; Michel, C.; Simon, R.S.; Spreng, W.; Wollersheim, H.J.; Khoo, T.L.; Chowdhury, P.; Frekers, D. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Jan 1985. 30p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85751616.

Measurements of feeding times of high spin yrast states up to spin 30 (h/2π) in ^{154}Dy and 36 (h/2π) in ^{152}Dy were utilized to obtain information about possible spin dependent shape changes. The reactions ^{25}Mg (^{134}Xe, 5n), ^{124}Sn (^{34}S, 4n) and ^{25}Mg (^{132}Xe, 5n), ^{122}Sn (^{34}S, 4n) were used to populate the high spin states in ^{154}Dy and ^{152}Dy, respectively. Feeding times as well as lifetimes were determined with the recoil distance technique. In ^{152}Dy only long feeding times ($>=10$ ps) could be identified, indicating that the aligned-particle yrast states are fed through configurations of similar character, with little direct population from collective cascades in the continuum region. In ^{154}Dy discrete states with $I<=30$ (h/2π) have lifetimes which are characteristically collective, whereas the preyrast cascades exhibit both fast (< or approx.1 ps) and slow (proportional10 ps) feeding components. The latter imply a change with increasing spin from collective to aligned-particle character, probably associated with a prolate to oblate shape transition.

32736 (INIS-mf—9632, pp 4) Spin dependent deformation of ^{161}Ho probed by particle correlations. Ho, H. (Rijksuniversiteit Groningen (Netherlands). Kernfysisch Versneller Inst.). 19 Oct 1984. NTIS (US Sales Only), PC A02/MF A01. File Number DE85780923. (CONF-8410253—Summ.).

From Autumn meeting of the Dutch Association of Physics; Petten, Netherlands (19 Oct 1984).

Published in summary form only.

32737 (INIS-mf—9634) Investigation of the rotational nuclei ^{167}, ^{168}Hf and ^{170}, ^{171}W and the shell-model nucleus ^{26}Mg. Arciszewski, H.F.R. (Rijksuniversiteit Utrecht (Netherlands)). 6 Jun 1984. 102p. NTIS (US Sales Only), PC A06/MF A01. File Number DE85780926.

Includes Dutch summary; 64 refs.; 24 figs.; 9 tables.

Two gamma-gamma coincidence experiments on neighbouring nuclei that exhibit the backbending phenomenon are described. The first experiment performed with the cyclotron of the KVI at Groningen is an investigation of ^{167}Hf and ^{168}Hf, whereas in the second experiment, performed at the cyclotron facility of Louvain University, high spin states are studied and compared with predictions of the cranked shell model. A new method for the correction of the large background of Compton-scattered events is described. Apart from this, an investigation of the single particle (d,p) transfer reaction at ^{26}Mg has been performed with the van de Graaff tandem accelerator at 14 MeV. Specroscopic factors are presented for many levels up to an excitation energy of 8 MeV. Several new spin assignments could be made.

32738 Spectroscopy of the highest-spin states. Stephens, F. (Lawrence Berkeley Lab., CA (USA)). pp 205-216 of Proceedings of the International symposium on in-beam nuclear spectroscopy held at Debrecen, Hungary, 14-18 May 1984. Dombradi, Zs.; Fenyes, T. (eds.). Budapest, Hungary; Akademiai Kiado (1984). (CONF-840530—).

From International symposium on in-beam nuclear spectroscopy; Debrecen, Hungary (14 May 1984).

The reasons for constructing large arrays of Compton-suppressed germanium detectors are discussed and a description is given of the Berkeley array, presently under construction. Preliminary results from the Berkeley system are given for the nucleus sup(156)Er. A transition is seen, around spin 30, from collective rotational behaviour to non-collective single-particle behaviour. The transition depends on configuration, as well as spin.

32739 Competing nuclear structures in sup(182-188)Hg. Ramayya, A.V.; Ma, W.C.; Hamilton, J.H.; Robinson, S.J.; Zhao, K. (Vanderbilt Univ., Nashville, TN (USA). Dept. of Physics); Cole, J.D.; Zganjar, E.F. (Louisiana State Univ., Baton Rouge (USA). Dept. of Physics); Spejewski, E.H. (Oak Ridge Associated Universities, Inc., TN (USA). UNISOR). pp 317-329 of Proceedings of the International symposium on in-beam nuclear spectroscopy held at Debrecen, Hungary, 14-18 May 1984. Dombradi, Zs.; Fenyes, T. (eds.). Budapest, Hungary; Akademiai Kiado (1984). (CONF-840530—).

From International symposium on in-beam nuclear spectroscopy; Debrecen, Hungary (14 May 1984).

Recent experimental results in sup(182-188)Hg are presented. The levels in sup(182)Hg are identified for the first time. Presently available theoretical interpretations are discussed. The results indicate that there are multiple competing nuclear structures along the yrast line. It is interpreted that the gradual upbend of Isub(x) in the deformed band and the next super band are the result of aligning two hsub(9/2) or isub(13/2) protons.

6519 Nuclear Properties And Reactions, A=190-219

32740 (GANIL-P—84-09) Fission-fragment kinetic-energy distributions from a two-dimensional Fokker-Planck equation. Scheuter, F.; Gregoire, C.; Hofmann, H.; Nix, J.R. (Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France)). Sep 1984. 12p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85751339.

We calculate the fission-fragment kinetic-energy distribution for the compound nucleus ^{213}At by simultaneously taking into account spreading in a stretching degree of freedom and fluctuations in a fission degree of freedom. This is done in terms of an approximate solution of a two-dimensional Fokker-Planck equation obtained by propagating Gaussian bundles in momentum space. When compared as functions of nuclear temperature with experimental data, our calculated mean kinetic energies are in approximate agreement and our calculated variances are slightly too small.

32741 (GSI—85-3-Prepr.) Channel dependent sharing of the excitation energy in quasielastic reactions between ^{208}Pb + ^{86}Kr. Sohlbach, H.; Freiesleben, H.; Braun-Munzinger, P.; Kohlmeyer, B.; Marinescu, M.; Puehlhofer, F.; Schneider, W.F.W.; Schuell, D. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Jan 1985. 13p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85751649.

Energy spectra of quasielastic reaction products formed in ^{86}Kr bombardment of ^{208}Pb at various beam energies show broad structures that are shown to originate from sequential neutron emission following one or few nucleon transfer. A Monte Carlo simulation of the decay process is used to obtain information on the excitation energy sharing for primary fragments. Strong evidence is found for a channel dependent sharing of the excitation energy among the reaction partners.

32742 (INIS-mf—9238) **Inclusive and exclusive cross sections for the ^{3}He breakup on ^{197}Au. A test case for the DWBA approach in the post-formulation.** Kleinfeller, J. (Bonn Univ. (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet). 20 Dec 1983. 98p. (In German). NTIS (US Sales Only), PC A03/MF A01. File Number DE85780886.

The ^{3}He breakup on the ^{197}Au target for two projectile energies E = 24.8 MeV and E = 33.3 MeV was studied. Both incident energies lie near the Coulomb barrier of the target (24.1 MeV). The inclusive proton and deuteron spectra were measured in an angular range of 20°-155°. In the same angular range systematically (dp) and (pp) angular correlations were taken up. The contributions from the elastic and inelastic ^{3}He breakup in the inclusive proton and deuteron spectra were, as far as they could be separated, were compared with the prediction of a DWBA-description of the projectile breakup. The comparison extends to the p and d angular distribution of the inclusive breakup cross sections and the corresponding energy spectra, to the angular distributions of the elastic ^{3}He breakup into p and d, and to the energy dependence of this breakup channel. The reaction ^{197}Ausup(gs)(^{3}He,dp) ^{197}Ausup(gs) was kinematically completely determined by the (dp) coincident measurements, and can be compared in all angular correlations immediately with the predictions of the DWBA theory. The experimental data of the reaction ^{197}Au(^{3}He,2p) (^{197}Au + n)sup(*) with Esub(n)sup(cm) >= 0 were compared with the calculations of the DWBA approach in a semiclassical approximation. The results of the comparison show that the DWBA approach, which has been proved in the description of the deuteron breakup, describes also well the ^{3}He breakup into p and d. The semiclassical approach however yields less sufficient results. (orig./HSI).

32743 (INIS-mf—9299, pp 8-16) **Momentum flow in the 800 MeV/n Ar+Pb reaction.** Renfordt, R.E.; Schall, D.; Tittel, K. (Heidelberg Univ. (Germany, F.R.)); Brockmann, R.; Harris, J.W.; Maier, M.; Sandoval, A.; Stock, R.; Stroebele, H. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)); Pugh, H.G. 1984. NTIS (US Sales Only), PC A10/MF A01. File Number DE85780947. (CONF-840166—).

From 12. international workshop on gross properties of nuclei and nuclear excitations; Hirschegg, Austria (16 Jan 1984).

In this contribution results from 800 MeV/n Ar+Pb central collisions studied in the Streamer Chamber at the Bevalac are presented in terms of the azimuthally rotated flux tensor approach. (orig./HSI).

32744 (INIS-mf—9632, pp 3) **Neutron decay of the giant monopole resonance (GMR) in ^{208}Pb.** Borghols, W.T.A.; Brandenburg, S.; Drentje, A.G. (Rijksuniversiteit Groningen (Netherlands). Kernfysisch Versneller Inst.). 19 Oct 1984. NTIS (US Sales Only), PC A02/MF A01. File Number DE85780923. (CONF-8410253—Summ.).

From Autumn meeting of the Dutch Association of Physics; Petten, Netherlands (19 Oct 1984).

Published in summary form only.

32745 (INIS-mf—9632, pp 4) **Fission induced by heavy ions.** Crouzen, P.C.N.; Balster, G.J.; Boer, J. de; Bond, P.D.; Goldhoorn, P.B.; Meijer, R.J. de; Siemssen, R.H.; Wilschut, H.W.; Woude, A. van der (Rijksuniversiteit Groningen (Netherlands). Kernfysisch Versneller Inst.). 19 Oct 1984. NTIS (US Sales Only), PC A02/MF A01. File Number DE85780923. (CONF-8410253—Summ.).

From Autumn meeting of the Dutch Association of Physics; Petten, Netherlands (19 Oct 1984).

Published in summary form only.

32746 (INIS-mf—9632, pp 10) **Strong interaction effects in pionic ^{208}Pb.** Achard van Enschut, J.F.M. d' (Technische Hogeschool Delft (Netherlands)); David, P. (ISKP Bonn, Germany, F.R.); Duinker, W. (Nationaal Inst. voor Kernfysica en Hoge-Energiefysica (NIKHEF), Amsterdam (Netherlands). Sectie K). 19 Oct 1984. NTIS (US Sales Only), PC A02/MF A01. File Number DE85780923. (CONF-8410253—Summ.).

From Autumn meeting of the Dutch Association of Physics; Petten, Netherlands (19 Oct 1984).

Published in summary form only.

32747 (IPNO-DRE—83-24) **Anomalies in the heavy Hg isotopes.** Vergnes, M.; Berrier-Ronsin, G.; Rotbard, G. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). 1983. 12p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85751327.

The (p,t) reaction has been performed on natural Hg and separated ^{204}Hg, ^{202}Hg, ^{200}Hg, ^{198}Hg, ^{196}Hg targets, using a 25 MeV proton beam from the Orsay MP tandem accelerator and a split pole spectrometer. New excited 0^+ levels have been shown at 1410 keV in ^{202}Hg, 2250 in ^{200}Hg, 1775 in ^{198}Hg, 1450 and 1653 in ^{196}Hg and 1512 in ^{194}Hg. Striking discontinuities are observed in the energy behaviour of the 0_2^+ and in the cross sections of the 0_2^+ and 2_3^+ levels. The results are compared to IBM-2 calculations and to a recent microscopic calculation. It appears that the 0_2^+ in ^{200}Hg looks like an intruder state and that ^{200}Hg itself is anomalous as compared to the other Hg isotopes.

32748 (LYCEN—8343) **Study of the reaction α+Pb at 600 MeV.** Chamcham, K. (Lyon-1 Univ., 69 - Villeurbanne (France). Inst. de Physique Nucleaire; Lyon-1 Univ., 69 - Villeurbanne (France)). 1984. 92p. (In French). NTIS (US Sales Only), PC A05/MF A01. File Number DE85751299.

The α + Pb experiment at 600 MeV was realised at the Laboratoire National Saturne to search the Mach cone - Shock wave phenomenon in the nuclear matter. The light particles p, d, t, ^{3}He and ^{4}He were detected by surface barrier detectors. Inclusive measurements and angular correlations between two particles were realised. The inclusive spectras were analysed by the evaporation model. The contribution of the evaporative processes in the experimental angular distribution has been calculated by a Monte-Carlo simulation. The residual angular distribution manifests a peak around 45°, in agreement with theoretical predictions.

6520 Nuclear Properties And Reactions, A=220 And Above

REFER ALSO TO CITATION(S) 32791

32749 (CEA-CONF—7352) **Microscopic analysis of collective dynamics in low energy fission.** Berger, J.F.; Girod, M.; Gogny, D. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92 - Montrouge (France)). May 1984. 14p. (CONF-8405179—9). NTIS (US Sales Only), PC A02/MF A01. File Number DE85751337.

From International conference on theoretical approaches to heavy ion reaction mechanisms; Paris, France (14 May 1984).

A microscopic description based on the density - dependent Hartree-Fock-Bogolyubov approach with several kinds of constraints is used to extract the characteristic features of the collective dynamics of the fission process at low energy. The dynamical behaviour of the nucleus beyond the second saddle point and a mechanism for scission are deduced. They are analyzed in the framework of a quantum-mechanical treatment of collective dynamics taking into account the variations of the collective inertia.

32750 (FEI—1404) **Parameters of the multilevel analysis of the Pu-239 cross sections in resonance region.** Kolesov, V.V.; Luk'yanov, A.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1983. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85701018.

On the basis of the program of joint multilevel analysis of total cross section and fission cross section, which has been previously developed in details and tested, a coordinated set of resonance parameters of formalism of S-matrix for Pu-239, reproducing data on energy dependence of the cross sections up to the energy 530 eV, is obtained. Calculation results according to parameters of the average cross sections in separate energy ranges and their comparison with the known evaluations are also given.

32751 (INIS-mf—9532, pp 283-288) **Semi analytical derivation of the LSS parameters.** Dickstein, P.A.; Ingman, D. (Technion-Israel Inst. of Tech., Haifa. Dept. of Nuclear Engineering). 1983. NTIS (US Sales Only), PC A14/MF A01. File Number DE85780892. (CONF-831241—Summ.).

From Joint US/Israeli meeting on safety and siting problems for power reactors in a small country; Haifa, Israel (20 Dec 1983).

Published in summary form only.

32752 (NAC-AR—84-01, pp 166-168) **Report of the Van de Graaff Group: nuclear reactions and nuclear structure. Neutron spectrum from ^{252}Cf fission.** Allie, M.S.; Brooks, F.D.; Cilliers, W.A. (Cape Town Univ. (South Africa)). 1984. NTIS (US Sales Only), PC A14/MF A01. File Number DE85780939.

Short note.

In Annual report June 1984. [Council for Scientific and Industrial Research, Faure (South Africa). National Accelerator Center].

32753 **Anomalous positron peaks from supercritical collision systems.** Cowan, T.; Backe, H.; Begemann, M.; Bethge, K.; Bokemeyer, H.; Folger, H.; Greenberg, J.S.; Grein, H.; Gruppe, A.; Kido, Y.; Kluever, M.; Schwalm, D.; Schweppe, J.; Stiebing, K.E.; Trautmann, N.; Vincent, P. (Gesellschaft fuer Schwerionenforschung, D-6100 Darmstadt, Federal Republic of Germany; A. W. Wright Nuclear Structure Laboratory, Yale University, New Haven, Connecticut 06511; University of Frankfurt, D-6000 Frankfurt am Main, Federal Republic of Germany; University of Heidelberg,). *Physical Review Letters;* **54**: No. 16, 1761-1764(22 Apr 1985). Contract AC02-76ER03074.

Narrow positron peaks are observed in five supercritical collision systems with combined nuclear charge 180< or =Z/sub u/ < or =188. The peaks do not originate from nuclear internal pair conversion and their production appears to occur in a narrow projectile energy interval near the Coulomb barrier. The line shapes are consistent with emission by a source moving with the c.m. velocity. Particularly notable is an apparent independence of the peak energies on Z/sub u/. These observations are discussed in the context of the spontaneous decay of the QED vacuum and other new potential sources of line positron spectra.

6530 Nuclear Theory

32754 (CEA-CONF—7330) **Electrons and photons: a probe for short distance study of nuclei.** Gerard, A. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). 1983. 14p. (In French). (CONF-8309242—2). NTIS (US Sales Only), PC A02/MF A01. File Number DE85751331.

From Meeting of the French Society of Physics; Grenobel, France (19 Sep 1983).

Study of nuclear interactions using electron and photon beams between 100 and 700 MeV energy has shown the limitations of the mean field theory, and given unambiguous evidence for meson exchange currents and Δ resonance propagation. Continuing the investigation at higher energies (1-3 GeV) would permit to deepen further these discoveries and probe the short and very short range parts of nuclear interactions, thus specifying the role of quarks in the nuclear dynamics.

32755 (CEA-CONF—7380) **Some aspects of heavy ion macrophysics.** Ngo, C. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Jul 1984. 50p. (CONF-840708—2; DPh-N-S—2181). NTIS (US Sales Only), PC A03/MF A01. File Number DE85751302.

From International school of heavy ion physics - frontiers in nuclear dynamics course; Erice, Trapani, Italy (16 Jul 1984).

In these notes we review, in a schematic way, some aspect of the physics with heavy ions. In the first lecture we review how is possible to describe the dissipative phenomena observed above the Coulomb barrier, up to 10-15 MeV/u, using transport theories. The second lecture is devoted to the question of fusion and the appearance of a new mechanism: fast fission. It is shown that one can now have a global understanding of these phenomena within single picture. The third lecture presents, in a simplified way, some results obtained recently with heavy ions in the range of 30-50 MeV/u at GANIL and SARA.

32756 (CONF-850507—7) **Pairing correction of particle-hole state densities for two kinds of Fermions.** Fu, C.Y. (Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 5p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85011549.

From International conference on nuclear data for basic and applied science; Santa Fe, NM, USA (13 May 1985).

Pairing corrections in particle-hole (exciton) state-density formulas used in precompound nuclear reaction theories are, strictly speaking, dependent on the nuclear excitation energy U and the exciton number n. A general formula for (U,n)-dependent pairing corrections has been derived in an earlier paper for exciton state-density formulas for one kind of Fermion. In the present paper, a similar derivation is made for two kinds of Fermions. It is shown that the constant-pairing-energy correction used in standard level-density formulas, such as U_0 in Gilbert and Cameron, is a limiting case of the present general (U,n)-dependent results.

32757 (GSI—84-66-Prepr.) **Dynamics of the nuclear disassembly in a field-theoretical model at finite entropies.** Knoll, J.; Strack, B. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Oct 1984. 10p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85780957.

The expansion phase of a hot nuclear system as created in an energetic heavy-ion collision is calculated and discussed by a self-consistent field-theoretical model. Dynamical instabilities arising during the expansion from strong fluctuations of the one-body density are included explicitely. First multiplicity distributions and mass spectra resulting from a series of numerical runs in a 2+1 dimensional model world are presented. The dependence of break-up dynamics both on the properties of the binding force and possible correlations in the initially compressed hot state are discussed.

32758 (GSI—84-69-Prepr.) **Random-walk simulation of selected aspects of dissipative collisions.** Toeke, J.; Gobbi, A.; Matulewicz, T. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Nov 1984. 43p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85751125.

Internuclear thermal equilibrium effects and shell structure effects in dissipative collisions are studied numerically within the framework of the model of stochastic exchanges by applying the random-walk technique. Effective blocking of the drift through the mass flux induced by the temperature difference, while leaving the variances of the mass distributions unaltered is found possible, provided an internuclear potential barrier is present. Presence of the shell structure is found to lead to characteristic correlations between the consecutive exchanges. Experimental evidence for the predicted effects is discussed.

32759 (GSI—84-70-Prepr.) **Distorted-wave Born-approximation theory of heavy-ion induced projectile break-up reactions.** Shyam, R.; Nagarajan, M.A. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Nov 1984. 46p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85751126.

A distorted-wave Born-approximation (DWBA) formalism is developed to describe the elastic and inelastic break-up of the projectile in the heavy ion induced reactions. Using a local momentum approximation and the surface localization property of these reactions expressions for the DWBA transition amplitude are derived. One of the attractive features of the present formulation is the fact that the readial integrals involved in it are the same as those contained in the transition amplitude evaluated with a zero range approximation. The validity of the approximations used in our derivations has been tested and it is shown that these approximations are well fulfilled.

32760 (INIS-mf—9299, pp 129-135) **New quantum chromodynamical viewpoint in nuclear structure.** Bleuler, K. (Bonn Univ. (Germany, F.R.). Inst. fuer Theoretische Kernphysik). 1984. NTIS (US Sales Only), PC A10/MF A01. File Number DE85780947. (CONF-840166—).

From 12. international workshop on gross properties of nuclei and nuclear excitations; Hirschegg, Austria (16 Jan 1984).

The scope of this short contribution is to show that quark theoretical viewpoints do not only lead to a deeper understanding of the conventional theory but that they open at the same time a new and to some extent more direct way for the understanding of nuclear properties. (orig./HSI).

32761 (INIS-mf—9299, pp 23-33) **Towards the nuclear matter equation of state.** Harris, J.W.; Stock, R.; Bock, R.; Brockmann, R.; Sandoval, A.; Stroebele, H. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)); Odyniec, G.; Pugh, H.G.; Schroeder, L.S. (Lawrence Berkeley Lab., CA (USA)); Renfordt, R.E. 1984. NTIS (US Sales Only), PC A10/MF A01. File Number DE85780947. (CONF-840166—).

From 12. international workshop on gross properties of nuclei and nuclear excitations; Hirschegg, Austria (16 Jan 1984).

In the present study equilibrium rate calculations are used to show that thermal and chemical equilibrium should be reached during the high density stage and that freeze-out of the $\pi+\Delta$ chemical abundance occurs near the end of this stage, establishing the final pion multiplicity as a probe of the high density stage. The observed pion multiplicities are compared to predictions of a chemical model with Rankine-Hugoniot compression and an estimate of the nuclear matter equation of state will be made. (orig./HSI).

32762 (INIS-mf—9299, pp 88-94) **Canonical description of strangeness production in hot hadronic matter.** Redlich, K. (Wroclaw Univ. (Poland). Inst. Fizyki Teoretycznej). 1984. NTIS (US Sales Only), PC A10/MF A01. File Number DE85780947. (CONF-840166—).

From 12. international workshop on gross properties of nuclei and nuclear excitations; Hirschegg, Austria (16 Jan 1984).

The method for the description of particle production in hot hadronic matter in the canonical ensemble is presented. The particle multiplicity ratios in the limit of large volume (V) and baryon number (B) but fixed baryon number density rho=B/V are estimated. As an example the analytical expression for the ratio $<\Lambda>/<\Lambda$ anti $>$ as a function of the baryon number density and temperature is shown. (orig.).

32763 (INIS-mf—9299, pp 137-140) **Spatial instabilities in nuclear matter. A renormalizing fragmentation scenario.** Biro, T.S. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Niels Bohr Inst., Copenhagen (Denmark)); Bondorf, J.P. (Niels Bohr Inst., Copenhagen (Denmark)); Zimanyi, J. (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics); Theis, J. (Frankfurt Univ. (Germany, F.R.)). 1984. NTIS (US Sales Only), PC A10/MF A01. File Number DE85780947. (CONF-840166—).

From 12. international workshop on gross properties of nuclei and nuclear excitations; Hirschegg, Austria (16 Jan 1984).

In the present work we consider the case when during the dramatic cooling and expansion the nuclear system follows its trajectory in the temperature density plane even into the unstable regime keeping its energy constant. (orig./HSI).

32764 (INIS-mf—9299, pp 45-52) **Dynamics of the nuclear disassembly in a field-theoretical model at finite entropies.** Knoll, J.; Strack, B. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). 1984. NTIS (US Sales Only), PC A10/MF A01. File Number DE85780947. (CONF-840166—).

From 12. international workshop on gross properties of nuclei and nuclear excitations; Hirschegg, Austria (16 Jan 1984).

The expansion phase of a hot nuclear system as created in an energetic heavy ion collision is calculated and discussed by a self-consistent field-theoretical model which considers dynamical growth of instabilities arising from strong fluctuations of the one-body density. First multiplicity distributions and mass spectra resulting from a series of numerical runs in a 2+1 dimensional model world are presented. The dependence of the break-up dynamics both on the properties of the binding force and possible correlation in the initially compressed hot state are discussed. (orig.).

32765 (INIS-mf—9299, pp 67-73) **What we can learn from pion and proton spectra in relativistic heavy ion collisions.** Brockmann, R.; Harris, J.W.; Maier, M.; Sandoval, A.; Stock, R.; Stroebele, H. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)); Odyniec, G.; Pugh, H.G.; Schroeder, L.S. (Lawrence Berkeley Lab., CA (USA)); Renfordt, R.E. (Heidelberg Univ. (Germany, F.R.). Inst. fuer Hochenergiephysik). 1984. NTIS (US Sales Only), PC A10/MF A01. File Number DE85780947. (CONF-840166—).

From 12. international workshop on gross properties of nuclei and nuclear excitations; Hirschegg, Austria (16 Jan 1984).

We have shown that the fireball model as well as the cascade model describe the data reasonably, each model with some deficiencies. Whereas the spectra agree, the density with which every model is dealing does not. In the cascade model densities of 3-4 rho$_0$ (rho$_0$=.17 fm^3) are obtained, whereas in the thermodynamical model only densities of 1.5 rho$_0$ are reached. (orig./HSI).

32766 (INIS-mf—9299, pp 95-111) **Coherent photon radiation from nuclei as a probe of impact parameters and nucleon velocity distributions in ultrarelativistic nuclear collisions.** Bjorken, J.D.; McLerran, L. (Fermi National Accelerator Lab., Batavia, IL (USA). Theory Group). 1984. NTIS (US Sales Only), PC A10/MF A01. File Number DE85780947. (CONF-840166—).

From 12. international workshop on gross properties of nuclei and nuclear excitations; Hirschegg, Austria (16 Jan 1984).

Photons which are coherently produced when nucleons are accelerated during the collision of ultra-relativistic nuclei are studied as probes of the impact parameter of the collision and of the rapidity distribution of the nucleons. (orig.).

32767 (INIS-mf—9299, pp 112-114) **Detonation waves and quark matter formation in ultrarelativistic heavy ion reactions.** Csernai, L.P. (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). 1984. NTIS (US Sales Only), PC A10/MF A01. File Number DE85780947. (CONF-840166—).

From 12. international workshop on gross properties of nuclei and nuclear excitations; Hirschegg, Austria (16 Jan 1984).

Detailed studies of detonation and deflagration waves in quark-gluon plasma have discussed the plasma of vanishing baryon density and chemical potential nsub(B)=μsub(B)=0, which is assumed to be formed in the mid rapidity range of ultrarelativistic heavy ion reactions. According to the recent lattice QCD calculations of Hasenfratz et al., including both quarks and gluons for such zero baryon charge plasma, phase transition may occur only if the quark masses are larger than one GeV. Hence at the presently expected quark masses no phase transition can be present in the mid rapidity region. Some of the simpler calculations show this feature for nsub(B)=μsub(B)=0, but for nonzero baryon charge density a first order phase transition is predicted. Thus, the signatures of the phase transition to quark-gluon-plasma can be studied mainly or even exclusively in the fragmentation region. (orig./HSI).

32768 (INIS-mf—9299, pp 115-120) **Quark-gluon plasma with a 15 GeV/N ^{16}O beam.** Graebner, G.; Buchwald, G.; Rentzsch, T.; Maruhn, J.A.; Greiner, W. (Frankfurt Univ. (Germany, F.R.). Inst. fuer Theoretische Physik); Stoecker, H. (Michigan State Univ., East Lansing (USA). Dept. of Physics and Astronomy). 1984. NTIS (US Sales Only), PC A10/MF A01. File Number DE85780947. (CONF-840166—).

From 12. international workshop on gross properties of nuclei and nuclear excitations; Hirschegg, Austria (16 Jan 1984).

3+1 dimensional calculations of the energy density attainable in the proposed CERN/BNL experiments are presented. The restriction to light beams (^{16}O) seems to impose severe limits to the chance of forming quark matter in these experiments. Collisions of heavy nuclei (e.g. Pb+Pb) would provide higher energy densities at lower bombarding energies. (orig.).

32769 (INIS-mf—9299, pp 124) **Color-conductivity in nuclei and the EMC-effect.** Nachtmann, O. (Heidelberg Univ. (Germany, F.R.). Inst. fuer Theoretische Physik); Pirner, H.J. (Heidelberg Univ. (Germany, F.R.). Inst. fuer Theoretische Physik; Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany, F.R.)). 1984. NTIS (US Sales Only), PC A10/MF A01. File Number DE85780947. (CONF-840166—).

From 12. international workshop on gross properties of nuclei and nuclear excitations; Hirschegg, Austria (16 Jan 1984).

Published in summary form only.

32770 (INIS-mf—9299, pp 141-143) **Linear momentum transfer studies at energies around 100 MeV/u.** Cassagnou, Y.; Conjeaud, M.; Dayras, R.; Harar, S.; Legrain, R.; Pollacco, E.; Volant, C. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Nucleaire a Basse Energie); Kankeleit, E.; Klotz, G.; Oeschler, H. (Technische Hochschule Darmstadt (Germany, F.R.). Inst. fuer Kernphysik). 1984. NTIS (US Sales Only), PC A10/MF A01. File Number DE85780947. (CONF-840166—).

From 12. international workshop on gross properties of nuclei and nuclear excitations; Hirschegg, Austria (16 Jan 1984).

In order to characterize the reaction mechanism we take the linear momentum transferred from the projectile to the target. This quantity is accessible by the measurement of the angle and velocities of the fission fragments. By the use of heavy targets such as Th nearly all reactions terminate by fission and a general view of the occurring mechanisms can be obtained. On the other hand, if lighter target nuclei are used whereby fission is less probable, only a selected range of impact parameters leads to fission. These two aspects mark the structure of my talk: In the first part, based on the measurements on Th, a classification of the reaction mechanisms is proposed, and in the second part, data on lighter nuclei are discussed whereby high transferred momenta are selected. These two parts are represented by two proposals; the first experimental series is finished and the second one has just started. (orig.).

32771 (INIS-mf—9302) **Study of collective coordinates and dynamical groups in nuclear theory.** Papadopolos, Z. (Tuebingen Univ. (Germany, F.R.). Fakultaet fuer Physik). 22 Dec 1983. 142p. NTIS (US Sales Only), PC A07/MF A01. File Number DE85780922.

With 57 refs.

Lie-algebraic techniques for the group action on manifolds given as a direct product of coset spaces and group manifolds are developed. The microscopic realisation of the Mass Quadrupole Collective Model (MQC) in the S0(3)xSO(n) and GLsub(+)(3, R)xSO(n) schemes is studied. The problem of the separation of the kinetic energy and the velocity field into a collective and an intrinsic part is analyzed. Different coordinate schemes in phase space for the U(n)-invariant collective motion and the U(3) dynamical group are introduced. In the GL(3,C)xU(n) scheme, the invariant volume element in the new coordinates and a completely orthonormal basis is constructed. (orig.).

32772 (INIS-mf—9632, pp 7) **RPA screening of a meson-exchange force.** Hengeveld, W. (Vrije Univ., Amsterdam (Netherlands)). 19 Oct 1984. NTIS (US Sales Only), PC A02/MF A01. File Number DE85780923. (CONF-8410253—Summ.).

From Autumn meeting of the Dutch Association of Physics; Petten, Netherlands (19 Oct 1984).

Published in summary form only.

32773 (INIS-mf—9632, pp 7) **Shell-model calculation of strength functions.** Dean, G.W.R. (Rijksuniversiteit Utrecht (Netherlands). Robert van de Graaff Lab.). 19 Oct 1984. NTIS (US Sales Only), PC A02/MF A01. File Number DE85780923. (CONF-8410253—Summ.).

From Autumn meeting of the Dutch Association of Physics; Petten, Netherlands (19 Oct 1984).

Published in summary form only.

32774 (INIS-mf—9632, pp 7) **Structure of s- and d-pairs in the microscopic IBA.** Walet, N.R.; Brussaard, P.J. (Rijksuniversiteit Utrecht (Netherlands). Robert van de Graaff Lab.). 19 Oct 1984. NTIS (US Sales Only), PC A02/MF A01. File Number DE85780923. (CONF-8410253—Summ.).

From Autumn meeting of the Dutch Association of Physics; Petten, Netherlands (19 Oct 1984).

Published in summary form only.

32775 (INIS-mf—9632, pp 7) **Generalized seniority. A useful quantum number in nuclear spectroscopy.** Allaart, K. (Vrije Univ., Amsterdam (Netherlands)); Bonsignori, G. (Bologna Univ. (Italy)). 19 Oct 1984. NTIS (US Sales Only), PC A02/MF A01. File Number DE85780923. (CONF-8410253—Summ.).

From Autumn meeting of the Dutch Association of Physics; Petten, Netherlands (19 Oct 1984).

Published in summary form only.

32776 (INIS-mf—9632, pp 6) **Simple neutron resonances.** Abrahams, K. 19 Oct 1984. NTIS (US Sales Only), PC A02/MF A01. File Number DE85780923. (CONF-8410253—Summ.).

From Autumn meeting of the Dutch Association of Physics; Petten, Netherlands (19 Oct 1984).

Published in summary form only.

32777 (INIS-mf—9632, pp 3) **Isopin violating decay of the IAS.** Brandenburg, S.; Hofman, H.J.; Harakeh, M.N.; Grasdijk, P.; Werf, S.Y. van der (Rijksuniversiteit Groningen (Netherlands). Kernfysisch Versneller Inst.). 19 Oct 1984. NTIS (US Sales Only), PC A02/MF A01. File Number DE85780923. (CONF-8410253—Summ.).

From Autumn meeting of the Dutch Association of Physics; Petten, Netherlands (19 Oct 1984).

Published in summary form only.

32778 (INIS-mf—9632, pp 5) **Averaged neutron capture data and their applications to reaction mechanism.** Kopecky, J. 19 Oct 1984. NTIS (US Sales Only), PC A02/MF A01. File Number DE85780923. (CONF-8410253—Summ.).

From Autumn meeting of the Dutch Association of Physics; Petten, Netherlands (19 Oct 1984).

Published in summary form only.

32779 (INIS-mf—9633) **RITSSCHIL. A novel shell-model approach applied to light and heavy nuclei.** Zwarts, D. (Rijksuniversiteit Utrecht (Netherlands)). 19 Jun 1984. 103p. NTIS (US Sales Only), PC A06/MF A01. File Number DE85780924.

Includes Dutch summary; 43 refs.; 8 figs.; 11 tabs.

The programme RITSSCHIL is a FORTRAN77 computer code for large spectroscopic calculations in the microscopic nuclear shell model. It is suitable for all tensorial shell-model operators, such as hamiltonians and operators for electromagnetic transitions, (many-)particle transfer, beta decay, etc. Starting from matrix elements of standard operators in single shells RITSSCHIL calulates the matrix elements of the physical operators in a multishell basis. RITSSCHIL can treat a large variety of operators (e.g. for many-particle transfer) and it is very flexible, fast and uses little space. The essential features of the theory behind the formalism of programme RITSSCHIL are the use of second quantization and the representation of all states and operators in terms of irreducible spherical tensors. The approach is applied to heavy nuclei with 126 neutrons. Moreover it is applied in a rather unconventional way to very light nuclei (He, Li).

32780 (IPNO-DRE—83-10) **Fusion and competing reactions in central collisions at large excitation energies.** Lefort, M. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). 1983. 23p. (CONF-830340—4). NTIS (US Sales Only), PC A02/MF A01. File Number DE85751323.

From International conference on heavy-ion physics and nuclear physics; Catania, Italy (21 Mar 1983).

Two aspects of fusion reactions resulting from central collisions of complex nuclei are discussed. 1. The distinction between a mononuclear nucleus which undergoes fission and a true fully equilibrated spherical compound nucleus. The "extra push" model and the "dynamical" fission for l-waves close to l3sub(f)=O (Rotating Liquid Drop). 2. Large energy deposits and thermalization in Central collisions when the relative kinetic energy is increased in the region 20-80 MeV.A. What are the problems raised for the decay of such very excited high-spin nuclei.

32781 **(ISN—83-65) Four-body Yakubovsky differential equations for identical particles.** Merkuriev, S.P.; Yakovlev, S.L. (Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires). Dec 1983. 25p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85751292.

The differential equations for Yakubovsky components of the four-body wavefunctions are derived. An asymptotic form of these components is described. A symmetrized form of the Yakubovsky differential equations for four identical particles is given and its angular analysis is performed. Bound state calculations are presented for various potentials.

32782 **(ISN—84-12) Approach of chaos in deformed nuclei.** Carbonell, J.; Brut, F.; Arvieu, R.; Touchard, J. (Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires). Mar 1984. 10p. (CONF-840395—8). NTIS (US Sales Only), PC A02/MF A01. File Number DE85751334.

From Workshop on semi-classical methods in nuclear physics; Grenoble, France (5 Mar 1984).

The phase space of the trajectories of one neutron in a deformed single particle potential is sketched for A=16. The region of occurrence of the chaotic trajectories is found. The energy action surface is plotted for the simplest topology. Semi-classical energies are derived.

32783 **(ISN—84-13) Nuclear elasticity approach to giant resonances.** Jang, S. (Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires). Mar 1984. 12p. (CONF-840395—3). NTIS (US Sales Only), PC A02/MF A01. File Number DE85751304.

From Workshop on semi-classical methods in nuclear physics; Grenoble, France (5 Mar 1984).

The fragmentation of the isoscalar giant monopole and quadrupole resonances in deformed nuclei has been studied within the framework of the nuclear elasticity.

32784 **(ISN—84-14) General iteration scheme for the calculation of level densities, and results using a semiclassical approximation.** Blin, A.H.; Hiller, B.; Hasse, R.W.; Schuck, P. (Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires). Mar 1984. 10p. (CONF-840395—4). NTIS (US Sales Only), PC A02/MF A01. File Number DE85751309.

From Workshop on semi-classical methods in nuclear physics; Grenoble, France (5 Mar 1984).

A general scheme is derived to calculate m-particle n-hole fermion level densities for any single particle Hamiltonian taking into account Pauli exclusion. This technique is applied to obtain level densities of the three dimensional isotropic Harmonic Oscillator semiclassically in the Thomas-Fermi approach.

32785 **(ISN—84-15) Semiclassical calculations of the imaginary part of the nucleon-nucleus optical potential.** Hasse, R.W.; Schuck, P. (Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires). Mar 1984. 9p. (CONF-840395—5). NTIS (US Sales Only), PC A02/MF A01. File Number DE85751310.

From Workshop on semi-classical methods in nuclear physics; Grenoble, France (5 Mar 1984).

We calculate for finite nuclei the imaginary part of the nucleus-nucleon optical potential on and off shell by using the local Fermi gas approximation and a finite range two-body exchange force. Results are compared with those obtained by infinite nuclear matter calculations as well as using the local density or Glauber approximation.

32786 **(ISN—84-16) Semiclassical calculation of the nuclear response function at high momentum.** Stroth, U.; Hasse, R.W.; Schuck, P. (Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires). Mar 1984. 6p. (CONF-840395—6). NTIS (US Sales Only), PC A02/MF A01. File Number DE85751311.

From Workshop on semi-classical methods in nuclear physics; Grenoble, France (5 Mar 1984).

We calculate the nuclear response function in a semiclassic fashion. It is shown, that the obtained results are for high momentum transfers $q>=2\ \mathrm{fm}^{-1}$ in a very good agreement with an exact calculation.

32787 **(ISN—84-17) Classical properties and semiclassical calculations in a spherical nuclear average potential.** Carbonell, J.; Brut, F.; Arvieu, R.; Touchard, J. (Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires). Mar 1984. 10p. (CONF-840395—7). NTIS (US Sales Only), PC A02/MF A01. File Number DE85751312.

From Workshop on semi-classical methods in nuclear physics; Grenoble, France (5 Mar 1984).

We study the relation between the classical properties or an average nuclear potential and its spectral properties. We have drawn the energy-action surface of this potential and related its properties to the spectral ones in the framework of the EBK semiclassical method. We also describe a method allowing us to get the evolution of the spectrum with the mass number.

32788 **(ISN—84-20) Classical properties and semiclassical quantization of a spherical nuclear potential.** Carbonell, J.; Brut, F.; Arvieu, R.; Touchard, J. (Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires). Mar 1984. 45p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85751295.

The geometrical properties of the classical energy-action surface are studied for a nuclear Woods-Saxon-like spherical potential, in connection with the E.B.K. semiclassical method of quantization. Comparisons are made with other well known cases: the spherical harmonic oscillator and the spherical billiard. The shift of single particle energies from A = 208 to A = 16 is calculated by a simple method inspired by the Erhenfest adiabatic invariants. Semiclassical results are then compared with exact Schroedinger energies. It is seen that the most significant features of the single particle spectrum are explained by local properties of the energy action surface (curvature, slope) and by their evolution with the particle number.

32789 **(JINR—E-1-83-851) Energy- and A-dependences of the nucleon emission intensity in hadron-nucleus collisions.** Strugalski, Z. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1983. 8p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85701022.

The intensity of nucleon emission in high energy hadron-nucleus collisions is considered. Energy- and A-dependences of the mean proton intensity, measured by the mean proton multiplicity, observed in experiments, can be reproduced simply by the mean thicknesses of target nuclei, expressed in protons per some fm^2, and by the total cross section for hadron-nucleon collisions. Formulas are derived and tested experimentally within incident hadron energy range from 2 up to 3500 GeV, and within taract nucleus mass numbers 12-206.

32790 **(JINR—R-2-84-78) Density and entropy of the pion excitations in the nuclear matter.** Bunatyan, G.G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1984. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85701017.

The thermodynamical properties of the pion excitations in the isotopically symmetric nuclear matter are investigated. The expressions for the density and the entropy of the pion excitations are obtained, that are then transformed for the state of the system near by the pion field instability. The calculations have been fulfiled on the basis of the application of the quantum field theory methods in the many-body problem for nonzero temperature by means of the temperature Green functions. The obtained results give the dependence of the density and the entropy of the pion excitations on the temperature and density of the nuclear matter.

32791 (Juel—1960) **Validation of the intra-nuclear-cascade-evaporation model for particle production.** Filges, D.; Cloth, P.; Cierjacks, S.; Armstrong, T.W.; Hino, Y. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorentwicklung; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Kernphysik). Nov 1984. 194p. (KFK—3779). NTIS (US Sales Only), PC A09/MF A01. File Number DE85751639.

The intranuclear-cascade-evaporation model of HETC/KFA-1 has been used to predict the neutron production from nonelastic interactions of protons with several target materials: U, Pb, Ta, In, Nb, Fe, Al and C. These model predictions for a 590 MeV proton beam were compared with measurements of Cierjacks et al. made at the SIN cyclotron. In general the model predicts approximately the correct neutron production in the evaporation region, whereas in the high energy region (Esub(n) > 20 MeV) there are systematic discrepancies between measurement and model predictions, which tend to increase with increasing neutron energy and increasing emission angle.

32792 (LBL—19222) **Friction in nuclear dynamics.** Swiatecki, W.J. (Lawrence Berkeley Lab., CA (USA)). Mar 1985. Contract AC03-76SF00098. 36p. (CONF-850376—2). NTIS, PC A03/MF A01; GPO Dep. File Number DE85011984.

From Symposium on semiclassical descriptions of atomic and nuclear collisions; Copenhagen, Denmark (25 Mar 1985).

The problem of dissipation in nuclear dynamics is related to the breaking down of nuclear symmetries and the transition from ordered to chaotic nucleonic motions. In the two extreme idealizations of the perfectly Ordered Regime and the fully Chaotic Regime, the nucleus should behave as an elastic solid or an overdamped fluid, respectively. In the intermediate regime a complicated visco-elastic behaviour is expected. The discussion is illustrated by a simple estimate of the frequency of the giant quadrupole resonance in the Ordered Regime and by applications of the wall and window dissipation formulae in the Chaotic Regime. 51 refs.

32793 (LYCEN—8415) **Lorentz-Lorenz quenching for the Gamow-Teller sum rule.** Delorme, J.; Ericson, M.; Figureau, A. (Lyon-1 Univ., 69 - Villeurbanne (France). Inst. de Physique Nucleaire). Mar 1984. 13p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85751289.

We investigate the modification of the Gamow-Teller sum rule brought in by nucleonic excitations. The general trend of the data is well reproduced. The value of the force which mixes nucleonic and nuclear excitations is discussed.

32794 (NAC-AR—84-01, pp 172-173) **Report of the Van de Graaff Group: nuclear reactions and nuclear structure. Shell-model calculations in the s-d and f-p shells.** Richter, W.A.; Van der Merwe, M.G.; Froneman, S.; Naude, W.J. (Stellenbosch Univ. (South Africa)); Brown, B.A. (Michigan State Univ., East Lansing (USA). Cyclotron Lab.); Wildenthal, B.H. (Drexel Univ., Philadelphia, PA (USA)); Julies, R.E. (University of the Western Cape, Bellville (South Africa)). 1984. NTIS (US Sales Only), PC A14/MF A01. File Number DE85780939.

Short note.

In Annual report June 1984. [Council for Scientific and Industrial Research, Faure (South Africa). National Accelerator Center].

32795 **Probing heavy ion collisions with bremsstrahlung.** Ko, C.M.; Bertsch, G.; Aichelin, J. (Joint Institute for Heavy Ion Research, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physical Review* [*Section*] *C: Nuclear Physics;* **31**: No. 6, 2324-2326(Jun 1985).

We calculate bremsstrahlung spectra for intermediate energy heavy ion collisions to see the sensitivity of photon cross sections to reaction dynamics. Modeling the collisions with the intranuclear cascade, we find a clear collective quadrupole bremsstrahlung signal only for heavier nuclei, A>40. Maximum sensitivity to dynamics is likely for photons in the range of 10—30 MeV. For higher energy photons or lighter nuclei, there is a large background coming from the incoherent dipole component of the bremsstrahlung.

32796 **Complete fusion and quasifission in reactions between heavy ions.** Back, B.B. (Chemistry Division, Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review* [*Section*] *C: Nuclear Physics;* **31**: No. 6, 2104-2112(Jun 1985). Contract W-31-109-ENG-38.

It is shown that fission anisotropies from reactions with projectiles lighter than A = 20 are well described by the standard theory, in which it is assumed that the distribution of K values (projection of total spin I onto the symmetry axis) is determined at the fission saddle point. Angular anisotropies of symmetric fragments from heavy ion reactions with projectiles heavier than A = 24 are, however, substantially larger than expected on the basis of this theory, an observation which recently led to the suggestion that the K values adjust adiabatically during the descent from saddle to scission such that the observed final K distributions reflect a thermal equilibrium at the scission point. The predictions of such scission point models are compared with the available experimental data and it is shown that they fail to reproduce the observed trends as a function of bombarding energy for most systems. It is concluded that the observed deviation from the saddle point theory can be explained as a dynamical inhibition of complete fusion with heavy projectiles. An analysis is carried out in which the fraction of the symmetric fragment cross section originating from the fission decay of completely fused compound nuclei can be estimated. The systematics of the inhibition to complete heavy ion fusion is discussed in the framework of the extra push model.

32797 **Signals longitudinal hydrodynamic expansion in ultra-relativistic nucleus-nucleus collisions.** Ruuskanen, P.V. (California Univ., Berkeley (USA). Div. of Nuclear Science; Jyvaeskylae Univ. (Finland). Dept. of Physics). *Physics Letters,* [*Section*] *B;* **147**: No. 6, 465-468(15 Nov 1984).

The effects of hydrodynamics in the ultra-relativistic collisions of heavy nuclei are studied by using the results of numerical integration of hydrodynamic equations for longitudinal expansion. It is found that hydrodynamics may profoundly change the shape of the rapidity distribution of energy, dE/dtheta. In order to establish the existence of the hydrodynamic stage, both the rapidity distributions of the net baryon number, dnsub(B)/dtheta, and energy, dE/dtheta, should be studied simultaneously as functions of the size of the colliding nuclei.

6540 Radiation And Shielding Physics

REFER ALSO TO CITATION(S) 30784, 30788, 31942

32798 (CONF-850411—12) **Monte Carlo techniques for analyzing deep penetration problems.** Cramer, S.N.; Gonnord, J.; Hendricks, J.S. (Oak Ridge National Lab., TN (USA); CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France); Los Alamos National Lab., NM (USA)). 1985. Contract AC05-84OR21400. 16p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85011426.

From International meeting on advances in nuclear engineering computational methods; Knoxville, TN, USA (9 Apr 1985).

A review of current methods and difficulties in Monte Carlo deep-penetration calculations is presented. Statistical uncertainty is discussed, and recent adjoint optimization of splitting, Russian roulette, and exponential transformation biasing is reviewed. Other aspects of the random walk and estimation processes are covered, including the relatively new DXANG angular biasing technique. Specific items summarized are albedo scattering, Monte Carlo coupling techniques with discrete ordinates and other methods, adjoint solutions, and multi-group Monte Carlo. The topic of code-generated biasing parameters is presented, including the creation of adjoint importance functions from forward calculations. Finally, current and future work in the area of computer learning and artificial intelligence is discussed in connection with Monte Carlo applications. 29 refs.

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32799 (CONF-8505113—1) Calculation of heavy-ion tracks in liquid water. Hamm, R.N.; Turner, J.E.; Ritchie, R.H.; Wright, H.A. (Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 17p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85012101.

From 33. annual scientific meeting of the Radiation Research Society; Los Angeles, CA, USA (5 May 1985).

Detailed Monte Carlo calculations are presented of proton and alpha-particle tracks in liquid water. The computations treat the interactions of the primary particle and all secondary electrons on a statistical, event-by-event basis to simulate the initial physical changes that accompany the passage of an ion through water. Our methods for obtaining the cross sections needed for such calculations are described. Inelastic scattering probabilities (inverse mean free paths) are derived from a complex dielectric response function constructed for liquid water, based on experimental and theoretical data. Examples of partial cross sections for ionization and excitation by protons are shown. The computation of electron transport and energy loss includes exchange, elastic scattering, and a scheme for the delocalization of energy shared collectively by a large number of electrons in the condensed medium. Several examples of calculated proton and alpha-particle tracks are presented and discussed. The meaning and significance of the concept of a "track core" is briefly addressed in the light of this work. The present paper treats only the initial, physical changes produced by radiation in water (in $\sim 10^{-15}$ sec in local regions of a track). The work described here is used in calculations that we have reported in other publications on the later chemical development of charged-particle tracks. 10 refs., 6 figs.

32800 (FEI—1445) Approximation of angular distributions for elastically scattered neutrons. Korobejnikov, V.V.; Korobejnikova, L.V.; Nikolaev, M.N.; Tsibulya, A.M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1983. 20p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85701013.

Different methods used for description of the elastically scatted neutron angular distribution probability density developed specially for appication in calculations by the Monte-Carlo method are analyzed. Description of the program, which prepares information on elastic scattering anisotropy parameters in the convenient form is presented. Estimation of the effect of inaccuracy in neutron angular distribution on spatial distribution is performed.

32801 (FEI—1474) Investigations of an ionizing radiation transport in a nitrogen-containing medium. Volkov, V.S.; Kremenetskij, A.K.; Pavlov, G.M.; Pizaeva, L.N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1983. 21p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85701014.

The spectra of neutron and photon leakage from the surface of spherical or cubic form containers filled with ammonium nitrate (NH_4NO_3) with ^{252}Cf radionuclide source located in the centre of containers are investigated. The experimental data are compared with the ROZ2 program calculation. The calculation of neutron and photon radiation spectra is performed in the 28-group approximation of energy dependence for neutrons in the 0.5-15 MeV range and 15-group approximation for photons in the R_5 approximation of the scattering indicatrix in the 0.5-10 MeV range. The calculation data are shown to exceed the experimental data as a whole up to three times as much in the 3.5-5.5 MeV range.

32802 (INIS-mf—9459) Elaboration of a nodal method to solve the steady state multigroup diffusion equation. Study and use of the multigroup diffusion code DAHRA. Halilou, A.; Lounici, A. (Centre des Sciences et Technologie Nucleaires (CSTN), Algiers (Algeria)). Jan 1981. 125p. (In French). NTIS (US Sales Only), PC A06/MF A01. File Number DE85701118.

The subject is divided in two parts: In the first part a nodal method has been worked out to solve the steady state multigroup diffusion equation. This method belongs to the same set of nodal methods currently used to calculate the exact fission powers and neutron fluxes in a very short computing time. It has been tested on two dimensional idealized reactors. The effective multiplication factor and the fission powers for each fuel element have been calculated. The second part consists in studying and mastering the multigroup diffusion code DAHRA - a reduced version of DIANE - a two dimensional code using finite difference method.

32803 (NEANDC(J)—111/A) Activities of Working Group on Atomic, Molecular and Nuclear Data for Medical Science. (Japanese Nuclear Data Committee, Tokai, Ibaraki). 1985. 133p. (In Japanese). (INDC(JPN)—97/G; JAERI-M—85-024). JAERI, Tokai-mura, Naka-gun, Ibaraki-ken 319-11, Japan. File Number TI85901538.

This is a report on the activities of the Working Group on Atomic, Molecular and Nuclear Data for Medical Science, Japanese Nuclear Data Committee in the fiscal years of 1982 and 1983. This report consists of (1) brief reviews on stopping powers of charged particles and electrons and related topics, and on problems to use these data for practical radiotherapy, (2) reports on the investigation of the present status of data activities in other countries, (3) references, and (4) future plans after 1984.

32804 (PB—85-172203) Neutron-induced reactions and secondary-ion mass spectrometry: complementary tools for depth profiling. Final report. Downing, G.; Fleming, R.; Simons, D.; Newbury, D. (National Bureau of Standards, Washington, DC (USA)). 1982. 4p. Pub. in Proceedings of Annual Conference of the Microbeam Analysis Society (17th), Washington, DC., August 9-13, 1982, p219-221.

The technique of neutron depth profiling is based upon inducing nuclear reactions by bombardment with low-energy neutrons. The nuclear reactions result in the emission of high-energy alpha particles or protons. The energy spectrum of the emitted particles is used to derive a depth distribution by transforming the energy loss into an equivalent depth by stopping-power calculations. Depth profiles of bismuth distributions in silicon and tin have been measured by both neutron depth profiling and secondary ion mass spectrometry. Information from both techniques can be used synergistically to aid in a full characterization of the depth distribution.

32805 (PUC-TN—06/83) Multiphoton absorption coefficients in solids: an universal curve. Brandi, H.S.; Araujo, C.B. de. (Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Fisica). Apr 1983. 19p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85701431.

An universal curve for the frequency dependence of the multiphoton absorption coefficient is proposed based on a 'non-perturbative' approach. Specific applications have been made to obtain two, three, four and five photons absorption coefficient in different materials. Properly scaling of the two photon absorption coefficient and the use of the universal curve yields results for the higher order absorption coefficients in good agreement with the experimental data.

32806 (PUC-TN—12/83) Non-linear absorption in solids. Brandi, H.S.; Jalbert, G.; Malta, O.L. (Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Fisica). Jun 1983. 17p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85701432.

Multiphoton transitions in direct-gap crystals are studied considering a 'non-perturbative' approach, similar to Keldysh approximation. A simple two parabolic band model in the effective mass approximation is considered, so that exact solutions associate to the full, crystal plus field, Hamiltonian may be approximated by Volkov wavefunctions. In this manner an S matrix is constructed which incorporates the electromagnetic field to all orders in an approximated way, leading to analytical solutions for the multiphoton transition rates. The use of the saddle point method and its limitations as well as the connection between multiphoton absorption and tunneling is discussed. It is shown that the Keldysh approach is fairly accurate as long as terms arising from the saddle point integration are consistently accounted.

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32807 **(RAL—84-064) Profile refinement of powder diffraction patterns using the Voigt function.** David, W.I.F.; Matthewman, J.C. (Rutherford Appleton Lab., Chilton (UK)). Aug 1984. 14p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700989.

The Voigt function has been incorporated as a peak-shape description into a program for the refinement of constant wavelength X-ray and neutron diffraction patterns. The results obtained for neutron diffraction indicate that the Voigt function describes the profile peak shape to high accuracy even in the presence of substantial line broadening from particle-size effects.

32808 **(RAL—84-077) Deconvolution of liquid structure data: the pulsed neutron source case.** Howells, W.S. (Rutherford Appleton Lab., Chilton (UK)). Aug 1984. 11p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700990.

The moments method for deconvoluting experimental data from the resolution function, which has previously been investigated for reactor diffractometers, has been adapted and shown to be suitable for time-of-flight techniques as employed on pulsed neutron sources.

32809 **(SAND—85-0564C) Coupled electron-photon transport calculations using the method of discrete ordinates.** Lorence, L.J. Jr.; Nelson, W.E.; Morel, J.E. (Sandia National Labs., Albuquerque, NM (USA); Science and Engineering Associates, Inc., Albuquerque, NM (USA); Los Alamos National Lab., NM (USA)). 1985. Contract AC04-76DP00789. 6p. (CONF-850711—4). NTIS, PC A02/MF A01; GPO Dep. File Number DE85009444.

From 22. annual conference on nuclear and space radiation effects; Monterey, CA, USA (22 Jul 1985).

A new discrete-ordinates method for coupled electron-photon transport is presented and applied to space shielding calculations. It is found that the discrete-ordinates method is as accurate as the standard Monte Carlo method, but is much more efficient.

32810 **(ZfK—531) MCANG - a group data library of cumulative angular distributions of elastically scattered neutrons for Monte Carlo calculations.** Boehmer, B. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). Jun 1984. 16p. (In German). NTIS (US Sales Only), PC A02/MF A01. File Number DE85701015.

A code has been written for producing group data suited to take into account the center of mass anisotropy of elastic neutron scattering in Monte Carlo calculations. The format of the generated data library is described. Up to now variants of the library based on KEDAK2 and KEDAK3/ENDL78 have been produced. One of the libraries is listed in the appendix.

32811 **Scaling law for the contact-propagation regime of first-passage percolation.** Kerstein, A.R. (Sandia National Laboratories, Livermore, California 94550). *Physical Review [Section] B: Condensed Matter;* 31: No. 11, 7472-7474(1 Jun 1985).

We study first-passage percolation on a lattice with a fraction p$<$ or $\approx$p/sub c/ of bonds assigned zero time delay, the others having finite delays governed by the cumulative distribution F(x). This "contact-propagation" regime exhibits criticality analogous to the random superconducting network. We derive, and confirm numerically, a scaling law that relates the divergence of the first-passage velocity near the percolation threshold p/sub c/ to static percolation exponents and to F(x).

32812 **One-dimensional model for three-dimensional transport in a pipe.** Larsen, E.W. (University of Calfornia, Los Alamos National Laboratory, Los Alamos, NM 87544). *Transport Theory and Statistical Physics;* **13**: No. 3, 599-614(Jul 1984).

We use a mathematical method to derive a one-dimensional model for particle transport in a pipe with reflecting walls. For the case of an evacuated pipe with particular reflecting boundary conditions for the walls, our model reduces to results obtained previously by Prinja and Pomraning.

32813 **Albedo operators and H-equations for generalized kinetic models.** van der Mee, C.V.M. (Laboratory for Transport Theory and Mathematical Physics, Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061, U.S.A.). *Transport Theory and Statistical Physics;* **13**: No. 2, 341-510(Apr 1984). Contract AS05-80ER10711.

For abstract kinetic equations on a half-line the albedo operator which gives the initial value as a function of the half-range boundary data, is written in terms of operator-valued generalizations of Chandrasekhar's H-functions, for which coupled non-linear equations are derived. Applications are given to transfer of polarized light, neutron transport and strong evaporation of liquids.

32814 **Linear transport in nonhomogeneous media. IV.** Larsen, E.W. (University of California, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Transport Theory and Statistical Physics;* **13**: No. 2, 511-531(Apr 1984).

A set of continuum and discrete eigenfunctoins, derived previously for half-space transport problems with a scattering ratio that is a bilinear function of position, is examined. For a Hoelder continuous angular flux incident on the half-space, this engenfunction set is proved to be half-range complete and the expansion coefficient for the continuum eigenfunctions is proved to be a continuous function of the spectral variable ν. Also, equations for the exiting flux, which are derived using this eigenfunction set, are proved to possess a unique, analytic solution.

32815 **Completeness theories in transport theory.** Zweifel, P.F. (Laboratory for Transport Theory and Mathematical Physics, Virginia Polytechnic Institut and State University, Blacksburg, Virginia 24061, U.S.A.). *Transport Theory and Statistical Physics;* **13**: No. 1, 57-106(Jan 1984). Contract AS05-80ER10711.

The role of self-adjoint operators in transport equations is considered. (AIP)

32816 **Acceleration of anisotropic transport iterations.** Williams, M. (Department of Mathematics, Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061). *Transport Theory and Statistical Physics;* **13**: No. 1, 127-140(Jan 1984). Contract AS05-80ER10711.

Fourier methods are used to study the stability of the associated difference scheme of transport theory (AIP).

6550 Medical Physics

REFER ALSO TO CITATION(S) 30031, 32012, 32273, 32327

32817 **(AECL—8266) Progress report: Health Sciences Division, 1983 July 1-December 31.** (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Feb 1984. 139p. (PR-HS—16). NTIS (US Sales Only), PC A07/MF A01. File Number DE85701531.

This report summarizes programs in health physics, radiation biology, environmental sciences and biomedical research. Health physics research included work on neutron dosimetry, thermoluminescent dosimetry, measurements of γ- and β-sensitivity of MOSFET detectors, tritium monitoring, a stack effluent monitor, and other radiation instruments. Environmental research included studies of heated plumes, radiotracer studies of flow through rock fractures, radionuclide cycling by plants, stable cobalt in fish, long-term radiation protection objectives for radioactive waste disposal, and tritium in surface waters in the CRNL vicinity. Radiation biology research continued to be concerned with DNA damage from radiation and carcinogenic chemicals, and enzymatic repair processes which help protect cells from such damage. In biomedical research the experiment to measure the fraction of HT in volunteers that is converted to HTO in vivo is progressing satisfactorily.

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32818 (AERE-R—11210) **Livermore phantom as a calibration standard in the assessment of plutonium in lungs.** Newton, D.; Wells, A.C.; Mizushita, S. (UKAEA Atomic Energy Research Establishment, Harwell. Environmental and Medical Sciences Div.). Jun 1984. 55p. HMSO, London, price Pound 6.00.

Five laboratories collaborated in assessing the validity of a phantom thorax, designed as a calibration standard for the determination of plutonium in lungs by counting of low-energy X rays. Counters were calibrated by reference to the response from eight men whose lungs contained sup(92m)Nb (emitting 15.8-17.7 keV X rays) in quantities which were known independently of X-ray counting, and the ensuing calibration factors were compared with those indicated by similar studies with the phantom. For the most common arrangement of counters, in which paired detectors view the anterior surfaces of the upper thorax, use of the phantom should on average give calibration factors correct to within 20 per cent or better, although for individual subjects errors approaching a factor of two are possible.

32819 (CONF-850506—4) **Microdosimetric spectra measurements of JANUS neutrons.** Marshall, I.R.; Williamson, F.S. (Argonne National Lab., IL (USA)). 1985. Contract W-31-109-ENG-38. 28p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85012108.

From 9. symposium on microdosimetry; Toulouse, France (20 May 1985).

Neutron radiation from the JANUS reactor at Argonne National Laboratory is being used with increasing frequency for major biological experiments. The fast neutron spectrum has a Kerma-weighted mean energy of 0.8 MeV and low gamma-ray contamination. In 1984 the JANUS fission converter plate of highly enriched uranium was replaced by one made of low-enriched uranium. We recorded microdosimetric spectra at several different positions in the high-flux irradiation room of JANUS before the change of the converter plate. Each set of measurements consisted of spectra taken at three different site diameters (0.5, 1.0, and 5.0 μm) and in both "attenuator up" and "attenuator down" configurations. At two conventional dosimetry reference positions, two sets of measurements were recorded. At three biological reference positions, measurements simulating several biological irradiation conditions, were taken. The dose rate at each position was estimated and compared with dose rates obtained previously by conventional dosimetry. Comparison of the different measurements showed no major change in spectra as a function of position or irradiation condition. First results from similar sets of measurements recorded after the installment of the new converter plate indicate no major change in the spectra. 11 refs., 4 figs., 5 tabs.

32820 (GRS-F—139) **Reports on radiation protection R and D projects of the Federal Ministry of the Interior in the year 1983.** (Bundesministerium des Innern, Bonn (Germany, F.R.); Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Garching (Germany, F.R.)). Oct 1984. 594p. (In German). NTIS (US Sales Only), PC A25/MF A01. File Number DE85751618.

The volume presents separate reports set up by the contractors or donees for documentation of the progress achieved within the framework of the various projects. The reports inform about the project purpose, work performed, results obtained, and further activities and goals. The full-text reports are preceeded by four different lists showing the report titles arranged according to terms of the radiation protection thesaurus, to project packages, to project numbers, and to an alphabetical subject index.

32821 (INIS-mf—9650, pp 4-6) **Conceptional background of the new radiation protection standards.** Tschurlovits, M. Mar 1984. (In German). NTIS (US Sales Only), PC A02/MF A01. File Number DE85780945.

In Oevs-Communication 1984/I.

Relation between doses and effects are considered. Non-stochastic and stochastic effects are distinguished. The concepts dose equivalent, collective dose and dose commitment are outlined.

32822 (INIS-mf—9650, pp 1-3) **New method of checking the shielding of medical radiography rooms.** Karacson, P. Mar 1984. (In German). NTIS (US Sales Only), PC A02/MF A01. File Number DE85780945.

In Oevs-Communication 1984/I.

A method to detect leaks in a room shielding during the comissioning of rooms containing X-ray equipment is described.

32823 (INIS-mf—9650) **Oevs-Communication 1984/I.** (Oesterreichischer Verband fuer Strahlenschutz (OeVS), Vienna). Mar 1984. 11p. (In German). NTIS (US Sales Only), PC A02/MF A01. File Number DE85780945.

Items within the scope of EDB have been entered individually into the data base. (ACR)

32824 (LA-UR—85-1616) **Treatment planning with ion beams.** Foss, M.H. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 4p. (CONF-850504—54). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85012661.

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

Ions have higher linear energy transfer (LET) near the end of their range and lower LET away from the end of their range. Mixing radiations of different LET complicates treatment planning because radiation kills cells in two statistically independent ways. In some cases, cells are killed by a single-particle, which causes a linear decrease in log survival at low dosage. When the linear decrease is subtracted from the log survival curve, the remaining curve has zero slope at zero dosage. This curve is the log survival curve for cells that are killed only by two or more particles. These two mechanisms are statistically independent. To calculate survival, these two kinds of doses must be accumulated separately. The effect of each accumulated dosage must be read from its survival curve, and the logarithms of the two effects added to get the log survival. Treatment plans for doses of protons, He^3 ions, and He^4 ions suggest that these ions will be useful therapeutic modalities.

32825 (NAC-AR—84-01, pp 246) **Report of the Research Group. Radiation safety and regulatory aspects.** Meyer, B.R.; Dirkse, J.A.M.T.; Conrad, F.M.P. 1984. NTIS (US Sales Only), PC A14/MF A01. File Number DE85780939.

In Annual report June 1984. [Council for Scientific and Industrial Research, Faure (South Africa). National Accelerator Center].

Radiation from SPC1 was produced for the first time during the latter half of 1983. Interim safety measures were adopted for protection of personnel against ionizing radiation. A large number of NAC staff members were registered as radiation workers and the health physics organization was set into motion. A training course, for educating radiation workers, was prepared and presented.

32826 (NRL—1983/1) **Radiation dosimetry of computed tomography x-ray scanners. Principles and techniques of measurement.** Poletti, J.L.; Williamson, B.D.P.; Le Heron, J.C. (National Radiation Lab., Christchurch (New Zealand)). 1983. 67p. NTIS (US Sales Only), PC A04/MF A01. File Number DE85701476.

This report describes the development and application of the methods employed in National Radiation Laboratory (NRL) surveys of computed tomography x-ray scanners (CT scanners). It includes descriptions of the phantoms and equipment used, discussion of the various dose parameters measured, the principles of the various dosimetry systems employed and some indication of the doses to occupationally exposed personnel.

32827 (NRPB-R—168) **Review of environmental radiation protection standards.** Hemming, C.R.; Clarke, R.H. (National Radiological Protection Board, Chilton (UK)). Oct 1984. 19p. HMSO, London, price Pound 4.00.

This report attempts to clarify the origins of the often confusing differences in the numerical limits described as radiological protection standards in various countries. The basic standards in use and their application in the UK are compared with the approach

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adopted in other countries. It is concluded that these differences do not reflect fundamental differences in the protection given to members of the public, but are a result of differing approaches to the application of the same basic system of dose limitation as recommended in ICRP Publication 26. It is shown that these differences do not necessarily lead to significant differences in the actual doses that may be received by members of the public as a result of a given practice.

32828 **(ORNL—6173) Twenty-first nuclear accident dosimetry intercomparison study, August 6-10, 1984.** Swaja, R.E.; Ragan, G.E.; Sims, C.S. (Oak Ridge National Lab., TN (USA)). May 1985. Contract AC05-84OR21400. 40p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85012076.

The twenty-first in a series of nuclear accident dosimetry (NAD) intercomparison (NAD) studies was conducted at the Oak Ridge National Laboratory's Dosimetry Applications Research Facility during August 6-10, 1984. The Health Physics Research Reactor operated in the pulse mode was used to simulate three criticality accidents with different radiation fields. Participants from five organizations measured neutron doses between 0.53 and 4.36 Gy and gamma doses between 0.19 and 1.01 Gy at area monitoring stations and on phantoms. About 75% of all neutron dose estimates based on foil activation, hair activation, simulated blood sodium activation, and thermoluminescent methods were within +-25% of reference values. Approximately 86% of all gamma results measured using thermoluminescent (TLD-700 or $CaSO_4$) systems were within +-20% of reference doses which represents a significant improvement over previous studies. Improvements observed in the ability of intercomparison participants to estimate neutron and gamma doses under criticality accident conditions can be partly attributed to experience in previous NAD studies which have provided practical tests of dosimetry systems, enabled participants to improve evaluation methods, and standardized dose reporting conventions. 16 refs., 15 tabs.

32829 **(SAND—85-0385C) Accuracy of coupled Monte-Carlo/next-event-estimator for bremsstrahlung dose predictions.** Pregenzer, A.L.; Halbleib, J.A. (Sandia National Labs., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 5p. (CONF-850711—3). NTIS, PC A02/MF A01; GPO Dep. File Number DE85009340.

From 22. annual conference on nuclear and space radiation effects; Monterey, CA, USA (22 Jul 1985).

The accuracy of an efficient new method for predicting combined x-ray production and dosimetry is evaluated at x-ray and γ-ray energies for commonly used detectors by comparing results with a full Monte Carlo treatment.

6560 Solid State Physics

REFER ALSO TO CITATION(S) 31428, 31586

32830 **(CBPF-NF—023/83) External stress influence on the spin-Peierls phase diagram of the XY model.** Lima, R.A.T. de; Tsallis, C. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1983. 12p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85701420.

Within a framework in which the structural degrees of freedom (assumed essentially three-dimensional) are adiabatically treated and the magnetic degrees of freedom are exactly treated, the stress-(magnetic) field-temperature phase diagram associated with the one-dimensional first-neighbour spin-1/2 magnetostrictive XY model is discussed. The important influence of the curvature of the coupling constant as a function of distance is exhibited and satisfactorily compared to experimental data.

32831 **(CBPF-NF—025/83) Criticality of the D=2 anisotropic quantum Heisenberg model.** Caride, A.O.; Tsallis, C.; Zanette, S.I. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1983. 11p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85701421.

Within a real space renormalization group framework, the square-lattice spin-1/2 Heisenberg ferromagnet in the presence of an Ising-like anisotropy is discussed. The controversial point on how T sub(c) vanishes in the isotropic Heisenberg limit is analyzed: quite strong evidence is presented favoring a continuous function of anisotropy. The crossover from the isotropic Heisenberg model to the pure Ising one is exhibited.

32832 **(IA—1404, pp 130-131) Probing the microstructure of the GDR in Pb-208.** Berant, Z.; Kahane, S.; Moreh, R.; Shahal, O. Jul 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85780940.

Published in summary form only.

In Research laboratories annual report 1983.

32833 **(INIS-mf—9649) Progress report 1983/1984 of the Institute for Theoretical Physics of the Technical University, Vienna.** Hafner, J. (ed.). (Technische Univ., Vienna (Austria). 1. Inst. fuer Theoretische Physik). Oct 1984. 36p. (In German). NTIS (US Sales Only), PC A03/MF A01. File Number DE85701532.

Overview of work in the fields solid state physics, statistical physics, mathmatical physics, elementary particle physics and quantum mechanics.

32834 **(PUC-TN—02/83) Dilute Potts chain in a magnetic field.** Chaves, C.M.; Riera, R. (Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Fisica). Mar 1983. 17p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85701424.

The Potts lattice gas in presence of a uniform magnetic field is solved exactly in one dimension. For negative values of the exchange parameter, the magnetization curve exhibits two or three steps, depending on the concentration of vacancies. These steps arise as a result of the competition between the exchange interaction and the magnetic field, being associated to different structural distribution of vacancies and to the magnetic ordering of one or both sublattices.

32835 **(PUC-TN—03/83) Renormalization group treatment for spin waves in the randomly disordered Heisenberg chain.** Chaves, C.M.; Koiller, B. (Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Fisica). Mar 1983. 11p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85701425.

Local densities of states in the randomly disordered binary quantum Heisenberg chain using a generalization of a recently developed approach based on renormalization group ideas are calculated. It envolves decimating alternate apins along the chain in such a way as to obtain recursion relations to describe the renormalized set of Green's function equations of motion. The densities of states are richly structured, indicating that the method takes into account compositional fluctuations of arbitrary range.

32836 **(PUC-TN—04/83) Renormalization group methods for the spectra of disordered chains.** Robbins, M.O.; Koiller, B. (Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Fisica). Mar 1983. 48p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85701426.

A family of real space renormalization techniques for calculating the Green's functions of disordered chains is developed and explored. The techniques are based on a recently proposed renormalization method which is rederived here and shown to be equivalent to a virtual crystal approximation on a renormalized Hamiltonian. The derivation suggests how other conventional alloy methods can be coupled to the renormalization concept. Various examples are discussed. Short-range order in the occupation of alloy sites and very general disorder in the Hamiltonian; diagonal, off-diagonal and environmental, are readily incorporated. The techniques are exact in the limits of high and low concentration and of complete short-range order, and for the Lloyd model. All states are found to be localized in agreement with exact treatments. Results for the alloy density of states are presented for various cases and compared to numerical simulations on long chains (10^5 atoms).

32837 **(PUC-TN—05/83) Landau theory for uniaxial systems near a Lifshitz point under applied fields.** Koiller, B.; Lederer, P. (Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Fisica). 1983. 20p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85701427.

A Landau-Ginzburg free-energy for uniaxial antiferromagnetic systems exhibiting modulate behaviour is introduced. The field-temperature phase diagrams obtained in the single-harmonic approximation have a triple point which, in some respects, resembles a Lifshitz point. Results for ferromagnetic systems are reproduced taking appropriate values for the parameters in the model. The behaviour of the magnetic susceptibility for finite fields is determined.

32838 **(PUC-TN—07/83) Critical phase for the antiferromagnetic Z(5) model on a square lattice.** Baltar, V.L.; Carneiro, G.M.; Pol, M.E.; Zagury, N. (Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Fisica). Apr 1983. 15p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85701428.

The existence of a critical phase for the antiferromagnetic Z(5) model on a square lattice is suggested based on results of Monte Carlo (MC) simulations and of Migdal Kadanoff Renormalization Group calculations (MKRG). The MKRG simulates a line of fixed points which it is interpreted as the locus of attraction of a critical phase. The MC simulations are compatible with this interpretation.

32839 **Kinetics of interfacial motion and bubble movement by vapor transport for a two-component solid solution.** Nichols, F.A. (Materials Science and Technology Division, Argonne National Laboratory, Argonne, Illinois 60439). *Journal of Applied Physics;* **58**: No. 1, 287-291(1 Jul 1985). Contract W-31-109-ENG-38.

The movement of solid-vapor interfaces through transport in the vapor phase has been analyzed by various authors for the case of a single component. When two components exist, the vapor contains more than one species. Such a case has often been analyzed using the total vapor pressure for such systems. We present here an analysis, allowing for preferential evaporation of one species and consequent surface enrichment of the less-volatile species. This leads to a velocity of motion of the form 1/V = 1/V/sub A/+1/V/sub B/, where V/sub A/ and V/sub B/ represent fictional velocities obtaining if only one species is rate controlling. Comparisons are made with some available data on congruently vaporizing compositions of mixed oxides and on the movement of lenticular voids in mixed oxides along thermal gradients, with very reasonable agreements obtained.

32840 **Calculated inverse photoemission cross sections from adsorbed molecules.** Johnson, P.D.; Davenport, J.W. (Department of Physics, Brookhaven National Laboratory, Upton, New York 11973). *Physical Review [Section] B: Condensed Matter;* **31**: No. 12, 7521-7525(15 Jun 1985).

A quantum-theoretical treatment is applied to calculate the cross section for emission of photons produced in inverse photoemission from an adsorbed molecule. Careful consideration of the type of potential that may be used in such calculations shows that photoemission and inverse photoemission from localized levels may be treated as time-reversed processes only above some minimum energy, approximately four times the threshold energy. In situations where time reversal may be used, a simple formula is derived relating the cross sections for photoemission and inverse photoemission. Examination of cross sections shows that the shape resonance frequently observed in photoemission as a final-state effect may manifest itself in inverse photoemission as an initial-state effect.

32841 **Universality among scalar spin systems.** Baker G.A. Jr.; Johnson, J.D. (Theoretical Division, Los Alamos National Laboratory, University of California, Los Alamos, New Mexico 87545). *Physical Review Letters;* **54**: No. 22, 2461-2461(3 Jun 1985).

A comment on critical behavior of the scalar Klauder and double Gaussi models in two dimensions is presented. AIP

32842 **Spin waves at surfaces and interfaces in cubic Heisenberg systems.** Xu, B.X.; Mostoller, M.; Rajagopal, A.K. (Department of Physics and Astronomy, Louisiana State University, Baton Rouge, Louisiana 70803). *Physical Review [Section] B: Condensed Matter;* **31**: No. 11, 7413-7423(1 Jun 1985).

The effects of the underlying crystal structure and the surface or interface normal on spin waves at surfaces and interfaces are examined for cubic crystals described by the Heisenberg Hamiltonian. For surfaces, cleavage and the Goldstone rule by themselves generally favor the formation of surface states. Interface states occur in nearly every case studied in simple model bicrystals. With the same perturbations, there are pronounced differences in the results obtained for different faces of the same crystal, or in those for the same face of different crystals.

32843 **Frozen-phonon total-energy determination of structural surface phase transitions: W(001).** Fu, C.L.; Freeman, A.J.; Wimmer, E.; Weinert, M. (Department of Physics and Astronomy, Northwestern University, Evanston, Illinois 60201). *Physical Review Letters;* **54**: No. 20, 2261-2264(20 May 1985). Contract AC02-76CH00016.

The prototypical W(001) structural phase transition is investigated by all-electron, frozen-phonon, total-energy calculations. The strong coupling between surface states and the M-bar$_5$ phonons plays a decisive role in favoring the reconstructed c(2 x 2) structure with a lateral <110> zig-zag displacement of 0.18 +- 0.01 A (in excellent agreement with experiment) and no interlayer relaxation. The transition from the (1 x 1) into the c(2 x 2) phase proceeds over a very flat region of the energy hypersurface and suppresses the relaxation.

32844 **Comment on "Dislocation-loop theory of the nematic—smectic A—smectic C multicritical point".** Bak, P.; Bruinsma, R. (Physics Department, Brookhaven National Laboratory, Upton, New York 11973). *Physical Review Letters;* **54**: No. 15, 1731-1731(15 Apr 1985). Contract AC02-76CH00016.

A comment on dislocation-loop theory of the Nematic-Smectic Multicriti Point is presented.

32845 **Approximate linear stability analysis of a model of adiabatic shear band formation.** Burns, T.J. (Sandia National Laboratories). *Quarterly of Applied Mathematics;* **43**: No. 1, 65-96(Apr 1985). Contract AC04-76DP00789.

The formation of adiabatic shear bands in ductile metals under dynamic loading conditions is generally thought to result from a material instability, which is associated with a peak in the curve of engineering plastic flow stress vs. engineering shear strain. This instability arises from the effect of thermal softening, caused by irreversible adiabatic heating, which counteracts the tendency of the material to harden with increasing plastic strain. An approximate linear stability analysis of a one-dimensional rigid-thermoviscoplastic model, based on data taken from dynamic torsion experiments on thin-walled tubes of mild steel, shows that shear band formation in this situation can be interpreted as a bifurcation from a homogeneous simple shearing deformation which occurs at the peak in the homogeneous stess vs. strain curve. The asymptotic method of multiple scales is used to show that the growth rate of small perturbations on the homogeneous deformation is controlled by the ratio of the slope of the homogeneous stress vs. strain curve to the material viscosity, i.e., the rate of change of the plastic flow stress with respect to the strain-rate. In addition, it is shown that this growth rate is essentially independent of wavelength in any small perturbation. Numerical methods are used to show that this growth rate beyond the bifurcation point may not be sufficiently large for the model to account for the experimental data, and some suggestions are made on how to modify the constitutive equation so that it better fits the experimental data.

6561 Superconductivity

REFER ALSO TO CITATION(S) 31458, 31467, 31499, 31525

32846 **Superconductivity of palladium tritide.** Schirber, J.E. (Sandia National Labs., Albuquerque, NM (USA)); Mintz, J.M.; Wall, W. (Sandia National Labs., Livermore, CA (USA)). *Solid State Communications;* **52**: No. 10, 837-838(Dec 1984).

The superconductivity and reverse isotope effect have been measured in high pressure tritium gas loaded palladium tritide (PdTsub(x) for x values from 0.72 to 0.81).

6570 Theoretical Physics

REFER ALSO TO CITATION(S) 32540, 32631

32847 **(AD-A—150622/9/XAB) Nonrelativistic Kapitza-Dirac scattering.** Coutsias, E.A.; McIver, J.K. (New Mexico Univ., Albuquerque (USA)). 1984. 56p. NTIS, PC A04/MF A01.

Techniques of singular perturbation theory are used to investigate the scattering of nonrelativistic charged particles by a standing light wave (Kapitza-Dirac scattering). Unlike previous treatments, explicit results are given for the effects of the time-dependent part of the field. For low field intensity/low particle energy, leading order effects can be found from an averaged equation and computed corrections. For the strong fields that can be produced by modern lasers and /or high particle energies, the time dependence of the potential leads to focusing. These methods can be applied to other problems with time-periodic potentials.

32848 **(CBPF-NF—001/83) Exact solution of the Einstein-Cartan field equations.** Roque, W.L.; Fonseca Teixeira, A.F. da. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1983. 12p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. File Number DE85701397.

The exact solution of Einstein-Cartan field equations is obtained for an artificial fluid with radially polarized spins, spherically symmetric and under static condition; the energy-momentum metric tensor is taken as zero. The gravitational dynamics is studied for various intensities of torsion (or fluid spin), through the analysis of motion of spinless test particles; in particular, for vanishing torsion we reobtain the Schwarzschild solution. The gravitational effects related to torsion are found sometimes attractive, sometimes repulsive, depending on the value of spin density and on the position and velocity of the test particle.

32849 **(CBPF-NF—007/83) Gravitational coupling of scalar and fermion fields to matter vorticity: microscopic asymmetries.** Soares, I.D.; Tiomno, J. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1983. 81p. NTIS (US Sales Only), PC A05/MF A01. File Number DE85701398.

The gravitational coupling of scalar fields and spin-1/2 fermions to matter vorticity is examined; it is considered in the context of Einstein's theory of gravitation and for technical simplicity the Godel model as the gravitational back-ground whose matter content has a non-null vorticity. Scalar field equation and Dirac equation are solved by separation of the field amplitudes into invariant angular-momentum and energy modes. For each case (scalar or Dirac field) these modes provide two distinct complete bases of solutions, which are bases for two representations of the algebra of the total 'angular momentum' of the system (one finite dimensional and the other infinite-dimensional). The presence of a vorticity field of matter generates, via gravitation, microscopic asymmetries in the physics of fermions. The 'angular-momentum' vector space appears to be polarized along the direction determined by the local vorticity Ω sup(→). Microscopic currents are asymmetric along the direction determined by the vorticity field: fermions (antifermions) currents are larger along the direction antiparallel (parallel) to the vorticity field. This current asymmetry as well other parity violating effects (for example, a split of mass for fermions) can in principle be used in devising experiments to detect the presence of a cosmological rotation of the universe, its direction and intensity. In case of production of pairs under CP violation a net number asymmetry may be generated between fermions and antifermions.

32850 **(CEA-CONF—7431) Collective variables and dissipation.** Balian, R. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Sep 1984. 32p. (CONF-8409225—1; SPhT—84-122). NTIS (US Sales Only), PC A03/MF A01. File Number DE85751555.

From Colloquium on heavy ion collisions; Cargese, France (2 Sep 1984).

This is an introduction to some basic concepts of non-equilibrium statistical mechanics. We emphasize in particular the relevant entropy relative to a given set of collective variables, the means of the projection method in the Liouville space, its use to establish the generalized transport equations for these variables, and the interpretation of dissipation in the framework of information theory.

32851 **(DESY—84-119) Strong coupling simulation of Euclidean quantum gravity.** Berg, B. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Dec 1984. 13p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85751636.

Relying on Regge calculus a systematic numerical investigation of models of 4d Euclidean gravity is proposed. The scale a = l_0 is set by fixing the expectation value of a length. Possible universality of such models is discussed. The strong coupling limit is defined by taking Planck mass msub(p) -> 0 (in units of l_0^{-1}). The zero order approximation msub(p) = 0 is called 'fluctuating space' and investigated numerically in two 4d models. Canonical dimensions are realized and both models give a negative expectation value for the scalar curvature density.

32852 **(DOE/ER/04999—T2) Finite temperature corrections to field theory: electron mass and magnetic moment, and vacuum energy.** Cox, P.H.; Hellman, W.S.; Yildiz, A. (Boston Univ., MA (USA). Dept. of Physics; Harvard Univ., Cambridge, MA (USA). Dept. of Physics). 1983. Contract AC01-78ER04999. 27p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85012907.

BUTP-83-001.

A finite temperature formalism which maintains Lorentz convariance is rederived and compared to other approaches. It is used to obtain the order-α temperature shifts in the electron mass and magnetic moment, vacuum energy. The mass and magnetic moment shifts, for kT << m, are of order $\alpha(kT/m)^2$ and hence beyond the present experimental observation limits. An explicit form for the general temperature mass shift is obtained.

32853 **(IFT-P—02/84) Determination of resonance energies and widths for short-range potentials.** Aguilera-Navarro, V.C.; Alves, N.A.; Zimerman, A.H.; Ley Koo, E. (Instituto de Fisica Teorica, Sao Paulo (Brazil)). 1984. 33p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85700971.

Resonance energies and widths are calculated for s and p waves in some spherically-symmetric short-range potentials, using the scattering-matrix, the threshold-matrix and the confinement-in-a-box methods. Numerical results and comparisons of the three methods are presented and discussed.

32854 **(IFT-P—04/84) Behaviour of the gravitational field around the initial singularity.** Francisco, G. (Instituto de Fisica Teorica, Sao Paulo (Brazil)). 1984. 31p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85700979.

The ultralocal representation of the canonically quantized gravitational field is used to obtain the evolution of coherent states in the immediate neighborhood of the singularity. It is shown that smearing functions play the role of classical fields since they correspond to cosmological solutions around the singularity. A special class of ultralocal coherent states is shown to contain the essential aspects of the dynamics of the system when we choose a simple representation for the field operators of the theory. When the ultralocality condition is broken a conjecture will be made about the quantum evolution of coherent states in the classical limit.

32855 **(IFT-P—08/83) Quantization in a spherical geometry.** Ferreira, P.L. (Instituto de Fisica Teorica, Sao Paulo (Brazil)). 1983. 27p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85700972.

Those non-linear systems which, at a classical level, are decribed by the Lagrangian $L=1/2$ $1/1+\Lambda r^2$ [x sup(.)^2 sub(approximately) - Λ (x sub(approximately).x sup(.) sub(approximately))^2/$1+\Lambda r^2$)]-V(r) are investigated. It is shown that this same Lagrangian corresponds to the nonrelativistic motion of a particles of unit mass, constrained to move on a N-sphere S sup(N), where a conservative center of force V(r) is defined. After examining some classical properties, a quantization procedure is discussed, which takes into account the geometrical symmetries involved. It is also shown that case $V(r)=1/2\omega^2 r^2$, corresponding to a isotropic harmonic oscillator in S sup(N), is exactly solvable. Explicit results on the energy spectrum and related eigenfunctions are given for arbitrary value of N. Some general features of the problem are also discussed.

32856 **(IFT-P—11/83) Quantum mechanics in the gaussian wave-packet phase space representation.** Mizrahi, S.S. (Instituto de Fisica Teorica, Sao Paulo (Brazil)). 1983. 37p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85700973.

Some results related to an alternative mapping formulation (to the well known Wigner-Weyl transform) which makes use of the Gaussian Wave Packet or coherent states representation 'pq> are presented. The pair p-q which labels this state, defines a phase-space in which the abstract operators P-circumflex, Q-circumflex, of momentum and position, are represented as differential operators. In the mapped expression of an operator A (P-circumflex, Q-circumflex), the quantum effects appear even when they are absent in the corresponding Wigner-Weyl transform.

32857 **(INIS-BR—254) Experimental display of Fourier analysis through the optical physics and its didatical utilization.** Oliveira, S.M.M. de. (Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Fisica). 1983. 146p. (In Portuguese). NTIS (US Sales Only), PC A07/MF A01. File Number DE85701393.

The properties of Fourier analysis through physical optics are displayed experimentally. Within physical optics topics that illustrate didactically Fourier analysis, a subject usually considered purely mathematical are selected. The most important properties of Fourier transform and their utilization in cleaning up images through spatial filtering are presented, in this way the properties of convolution to analyse image formation and characterize some diffraction patterns are also used.

32858 **(INIS-mf—9305) Perturbation of Schroedinger Hamiltonians by measures - self-adjointness and lower semiboundedness.** Brasche, J. (Bielefeld Univ. (Germany, F.R.). Fakultaet fuer Mathematik). Apr 1984. 23p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85780917.

We study the Hamiltonians for nonrelativistic quantum mechanics in one dimension in terms of energy forms $\int$vertical strokedf/dxvertical stroke^{2}dx+$\int$vertical strokefvertical stroke^2 d(μ-ν), where μ and ν are positive, not necessarily finite measures on the real line. We cover, besides regular potentials, also cases of very singular interactions (e.g., a particle interacting with an infinite number of fixed particles by 'delta function potentials' of arbitrary strengths). We give conditions for lower semiboundedness and closability of above energy forms which are sufficient and, for certain classes of potentials, (e.g. μ-ν a signed measure) also necessary. In contrast to the results in other approaches no regularity conditions and no restrictions on the growth of the measures μ and ν at infinity are needed. (orig.).

32859 **(IPP—6/244) Stochastic runaway of dynamical systems.** Pfirsch, D.; Graeff, P. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). Oct 1984. 30p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85780954.

One-dimensional, stochastic, dynamical systems are well studied with respect to their stability properties. Less is known for the higher dimensional case. This paper derives sufficient and necessary criteria for the asymptotic divergence of the entropy (runaway) and sufficient ones for the moments of n-dimensional, stochastic, dynamical systems. The crucial implication is the incompressibility of their flow defined by the equations of motion in configuration space. Two possible extensions to compressible flow systems are outlined.

32860 **(ITF—83-95-R) Description of the equilibrium states of the thermodynamic systems.** Kravchuk, N.V. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). Aug 1983. 24p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85700975.

The review of some recent results on the characterization of the equilibrium states of the infinite systems of quantum statistical mechanics is presented.

32861 **(ITF—83-120-R) Beta-functions of the nonlinear σ-models on some noncompact symmetric spaces.** Gavrilik, A.M. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). Sep 1983. 11p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85700974.

The expressions for renormalization group beta-functions of the nonlinear σ-models on the noncompact symmetric spaces $SO^*(2n)/U(n)$ and $SU^*(2n)/Sp(n)$ are found. The evaluation of the first coefficients of beta-functions is based upon certain isomorphisms of noncompact groups and some geometric properties of dual symmetric spaces.

32862 **(ITF—83-134-R) Dynamic systems in statistical physics.** Kravchuk, N.V. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). Oct 1983. 21p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85700970.

Non-commutative dynamic systems based on arbitrary *-algebras are investigated. A class of IA*-dynamic system is introduced and studied. Classes of equilibrium states of such systems are singled out by means of correlation inequalities. For certain classes of systems the correlation with KMS states is examined.

32863 **(JINR—11-83-875) Calculation of matrix elements of the three-body system relativistic Hamiltonian in adiabatic representation.** Bakalov, D. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1983. 13p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85700978.

Matrix elements of the three-body relativistic Hamiltonian in adiabatic representation are reduced to two-dimensional integrals of functions with integrable singularities in poles of the spheroidal coordinate system. A cubature formula for calculating the integrals is obtained, which provides relative accuracy $<= 10^{-5}$ for calculating matrix elements over wave functions of discrete spectrum of two-centre problem. The table is given which presents points and weights of cubature formula. A detailed description of MAIN program for calculation of matrix elements of operators in adiabatic representation is given. The main program is written in FORTRAN language and is oriented for CDC-6500 computer. Matrix elements of operators describing relativistic effects in mesic molecules of hydrogen isotopes are calculated by means of the MAIN program with $<= 10^{-5}$ relative accuracy.

32864 **(JINR—R-2-83-872) Quantum mechanics and Hopf fibre bundles. Green function.** Polubarinov, I.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1983. 19p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85700976.

A transformation from the Cartesian coordinates in 2-, 3- and 5-dimensional spaces to spinor ones is considered in two-body problems in quantum mechanics. These transformations are based on a two-fold covering of a circle by circle and on Hopf fibre bundles $S^3 \hookrightarrow S^2$ and $S^7 \hookrightarrow S^4$. Two-particle Green functions in the 2, 3 and 5 dimensions are represented to be integrals over fibres of some other Green functions in 2, 4 and 8 dimensions. Coulomb and free Green functions are expressed via well-known Green functions for many-dimensional harmonic oscillators.

32865 (JINR—R-4-84-100) **To the theory of scattering by two potentials.** Belyaev, V.B.; Zubarev, A.L.; Latipov, A.Sh. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1984. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85700977.

To investigate the off-shell properties of a two-body potential, we proposed to study the scattering amplitude on two potentials. We have analysed the behaviour of scattering lengths and phases on the whole potential as a function of the off-shell properties of one of the potentials. The largest sensitivity to the off-shell properties is observed at low energies.

32866 (LBL—19302) **Gravity theories in more than four dimensions.** Zumino, B. (Lawrence Berkeley Lab., CA (USA)). Mar 1985. Contract AC03-76SF00098. 7p. (CONF-8405312—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE85011164.

From Modern methods in quantum field theory conference; Amalfi, Italy (7 May 1984).

String theories suggest particular forms for gravity interactions in higher dimensions. We consider an interesting class of gravity theories in more than four dimensions, clarify their geometric meaning and discuss their special properties. 9 refs.

32867 (PUC-TN—25/83) **Recent developments in high-frequency scattering.** Nussenzveig, H.M. (Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Fisica). 1983. 14p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85701394.

Recent applications of the complex angular momentum theory of Mie scattering are reviewed: (i) very accurate asymptotic expansions for the average Mie cross sections for extinction, absorption and radiation pressure, averaged over a small range of size dispersion, have been obtained; (ii) forward optical glory effects have been predicted; (iii) A new diffraction effect, critical scattering, that takes place in the transition region around the critical scattering angle, has been treated, yielding results in good agreement with the exact Mie values. An overview of the major diffraction effects found in Mie scattering is also given.

32868 (PUC-TN—27/83) **Phase behavior in diffraction.** Checon, A. (Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Fisica). 1983. 15p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85701395.

Theoretical formulation of a straight edge diffraction shows a phase difference of $\pi/2$ between the incoming and diffracted waves. Experiments using two straight edges do not confirm the $\pi/2$ difference but suggest that the incoming wave is in phase with the wave diffracted into the shadowed region of the edge and out of phase by a factor of π with the wave diffracted into the illuminated region.

32869 (UWThPh—84-40) **Grassmann expansion of the classical N=2 supergravity field equations.** Embacher, F. (Technische Univ., Vienna (Austria). 1. Inst. fuer Theoretische Physik). 1984. 17p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85701399.

The classical field equations of N=2 supergravity are expanded with respect to an infinite dimensional Grassmann algebra. The general freedom in constructing classical solution is exhibited. As an application, a uniqueness theorem for supersymmetric extreme black holes is given.

32870 (UWThPh—84-42) **Geometric proof of Liouville's theorem.** Gruemm, H.R. (Technische Univ., Vienna (Austria). 1. Inst. fuer Theoretische Physik). 1984. 3p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85701396.

We present a geometric proof of Liouville's theorem on the existence of canonical coordinates for integrable systems.

32871 **Comparison of energy estimators used in quantum Monte Carlo calculations.** Doll, J.D.; Freeman, D.L. (Chemistry Division, University of California, Los Alamos National Laboratory, MS 6-738, Los Alamos, New Mexico 87545). *Journal of Chemical Physics;* **83**: No. 2, 768-771(15 Jul 1985).

Path-integral Monte Carlo calculations in quantum statistical mechanics have been performed using either discretized methods or Fourier methods. In each of these methods the internal energy has been calculated using either temperature differentiation or direct operation on the density matrix by the Hamiltonian. It is shown that the variance of the internal energy calculated by operation of the Hamiltonian on the density matrix in the Fourier method is independent of the number of Fourier components included in the expansion of the paths for a number of systems. The variance of the internal energy obtained from the other methods is shown to grow with the size of the expansion used for all systems.

32872 **Denominator function for canonical SU(3) tensor operators.** Biedenharn, L.C.; Lohe, M.A.; Louck, J.D. (Duke University, Durham, North Carolina 27706 and Los Alamos National Laboratory, Theoretical Division, Los Alamos, New Mexico 87545). *Journal of Mathematical Physics (New York);* **26**: No. 7, 1458-1492(Jul 1985). Contract W-7405-ENG-36.

The definition of a canonical unit SU(3) tensor operator is given in terms of its characteristic null space as determined by group-theoretic properties of the intertwining number. This definition is shown to imply the canonical splitting conditions used in earlier work for the explicit and unique (up to +- phases) construction of all SU(3) WCG coefficients (Wigner—Clebsch—Gordan). Using this construction, an explicit SU(3)-invariant denominator function characterizing completely the canonically defined WCG coefficients is obtained. It is shown that this denominator function (squared) is a product of linear factors which may be obtained explicitly from the characteristic null space times a ratio of polynomials. These polynomials, denoted G/sup t//sub q/, are defined over three (shift) parameters and three barycentric coordinates. The properties of these polynomials (hence, of the corresponding invariant denominator function) are developed in detail: These include a derivation of their degree, symmetries, and zeros. The symmetries are those induced on the shift parameters and barycentric coordinates by the transformations of a 3 x 3 array under row interchange, column interchange, and transposition (the group of 72 operations leaving a 3 x 3 determinant invariant). Remarkably, the zeros of the general G/sup t//sub q/ polynomial are in position and multiplicity exactly those of the SU(3) weight space associated with irreducible representation [q-1,t-1,0]. The results obtained are an essential step in the derivation of a fully explicit and comprehensible algebraic expression for all SU(3) WCG coefficients.

32873 **Cluster-size distributions for irreversible cooperative filling of lattices. I. Exact one-dimensional results for coalescing clusters.** Nord, R.S.; Hoffman, D.K.; Evans, J.W. (Ames Laboratory and Department of Chemistry, Iowa State University, Ames, Iowa 50011). *Physical Review [Section] A: General Physics;* **31**: No. 6, 3820-3830(Jun 1985). Contract W-7405-ENG-82.

We consider processes where the sites of an infinite, uniform lattice are filled irreversibly and cooperatively, with the rate of adsorption at a site depending on the state of its nearest neighbors (only). The asymmetry between empty and filled sites, associated with irreversibility, leads one to consider the closed infinite coupled hierarchies of rate equations for probabilities of connected and singly, doubly, etc., disconnected empty subconfigurations and results in an empty-site-shielding property. The latter allows exact solutions, via truncation, of these equations in one dimension and is used here to determine probabilities of filled s-tuples, f/sub s/ ($f_1$equivalentθ is the coverage), and thus of clusters of exactly s filled sites, n/sub s/equivalentf/sub s/-2f/sub s+1/+f/sub s+2/ for s< or =13 and 11, respectively. When all rates are nonzero so that clusters can coalesce, the f/sub s/ and n/sub s/ distributions decay exponentially as s→∞, and we can accurately estimate the asymptotic decay rate λ(θ)equivalent lim/sub s/→∞ f/sub s+1//f/sub s/equivalent lim/sub s/→∞ n/sub s+1//n/sub s/, where 0 = λ(0)< or =λ(θ)< or =λ(1) = 1. Divergent behavior of the average cluster size, as θ→1, is also considered.

32874 Statistical mechanical origin of the entropy of a rotating, charged black hole. Zurek, W.H.; Thorne, K.S. (Theoretical Astrophysics, Los Alamos National Laboratory, Los Alamos, New Mexico 87545 and California Institute of Technology, Pasadena, California 91125). *Physical Review Letters;* **54**: No. 20, 2171-2175(20 May 1985).

It is shown that the entropy of a rotating, charged black hole is, in senses made precise in the paper, (i) the logarithm of the number of quantum mechanically distinct ways that the hole could have been made, and (ii) the logarithm of the number of configurations that the hole's "atmosphere," as measured by stationary observers, could assume in the presence of its background noise of acceleration radiation. In addition, a proof is given of the generalized second law of thermodynamics.

32875 Statistical behavior in deterministic quantum systems with few degrees of freedom. Jensen, R.V.; Shankar, R. (Mason Laboratory, Yale University, New Haven, Connecticut 06520). *Physical Review Letters;* **54**: No. 17, 1879-1882(29 Apr 1985). Contract AC02-76ER03075.

Numerical studies of the dynamics of finite quantum spin chains are presented which show that quantum systems with few degrees of freedom (N = 7) can be described by equilibrium statistical mechanics. The success of the statistical description is seen to depend on the interplay between the initial state, the observable, and the Hamiltonian. This work clarifies the impact of integrability and conservation laws on statistical behavior. The relation to quantum chaos is also discussed.

32876 Resonance widths and positions by an algebraic approach. Alhassid, Y.; Iachello, F.; Levine, R.D. (A. W. Wright Nuclear Structure Laboratory, Yale University, New Haven, Connecticut 06511). *Physical Review Letters;* **54**: No. 16, 1746-1749(22 Apr 1985). Contract AC02-76ER03074.

The use of nonunitary discrete, irreducible representations of Lie algebras is proposed as a method for the determination of widths and energies of resonances. The method is illustrated by explicit application to three kinds of resonances: in transmission over a well, in transmission over a barrier, and in barrier penetration for a family of one-dimensional potentials. The same procedure is also useful in an algebraic approach to scattering by a complex (optical) potential, and for parametrizing of the resonant contribution to the scattering matrix.

32877 Asymptotic equivalence of Fokker-Planck and diffusion solutions for large time. Ganapol, B.D.; Larsen, E.W. (Department of Nuclear and Energy Engineering, University of Arizona, Tucson, Arizona 85721). *Transport Theory and Statistical Physics;* **13**: No. 3, 635-677(Jul 1984).

Some recent results of Beals and Protopopescu are obtained for a different class of problems using a simpler method of proof.

6580 Mathematical Physics

REFER ALSO TO CITATION(S) 32653, 32816, 32872, 33077

32878 (AD-A—151270/6/XAB) Very large least-squares problems and supercomputers. Rice, J.R. (Purdue Univ., Lafayette, IN (USA). Dept. of Computer Science). 31 Dec 1984. 17p. NTIS, PC A02/MF A01.

The goals of the workshop were: (a) to provide an interchange between different groups working on very large least-squares problems, (b) to provide an interchange between computer scientists involved with supercomputer systems and scientists using supercomputers and, (c) to assess the state of the art in solving very large least-squares problems. Twelve sources of very large least-squares problems were identified. The ones principally involved in the discussions were: geodetic surveys; photogrammetry; molecular structures; gravity field of the earth; and partial differential equations.

32879 (IFT-P—07/83) New algebraic tables of SU(2) quantities. Alcaras, J.A.C.; Vanagas, V. (Instituto de Fisica Teorica, Sao Paulo (Brazil)). 1983. 24p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85701117.

Formulas for Clebsch-Gordan Coefficients, 6-j symbols and 9-j symbols of SU(2) are presented in a ready-to-program way for obtaining algebraic tables. An excerpt of the complete tables are also presented.

32880 (SOL—85-1) Properties of a representation of a basis for the null space. Gill, P.E.; Murray, W.; Saunders, M.A.; Stewart, G.W.; Wright, M.H. (Stanford Univ., CA (USA). Systems Optimization Lab.). Feb 1985. Contract AT03-76ER72018. 19p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85012381.

Given a rectangular matrix A(x) that depends on the independent variables x, many constrained optimization methods involve computations with Z(x), a matrix whose columns form a basis for the null space of A/sup T/(x). When A is evaluated at a given point, it is well known that a suitable Z (satisfying A/sup T/Z = 0) can be obtained from standard matrix factorizations. However, Coleman and Sorensen have recently shown that standard orthogonal factorization methods may produce orthogonal bases that do not vary continuously with x; they also suggest several techniques for adapting these schemes so as to ensure continuity of Z in the neighborhood of a given point. This paper is an extension of an earlier note that defines the procedure for computing Z. Here, we first describe how Z can be obtained by updating an explicit QR factorization with Householder transformations. The properties of this representation of Z with respect to perturbations in A are discussed, including explicit bounds on the change in Z. We then introduce regularized Householder transformations, and show that their use implies continuity of the full matrix Q. The convergence of Z and Q under appropriate assumptions is then proved. Finally, we indicate why the chosen form of Z is convenient in certain methods for nonlinearly constrained optimization.

32881 Monte-Carlo error analysis in x-ray spectral deconvolution. Shirk, D.G.; Hoffman, N.M. (Applied Theoretical Physics Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87544). *Review of Scientific Instruments;* **56**: No. 5, 809-811(May 1985).

The deconvolution of spectral information from sparse x-ray data is a widely encountered problem in data analysis. An often-neglected aspect of this problem is the propagation of random error in the deconvolution process. We have developed a Monte-Carlo approach that enables us to attach error bars to unfolded x-ray spectra. Our Monte-Carlo error analysis has been incorporated into two specific deconvolution techniques: the first is an iterative convergent weight method; the second is a singular-value-decomposition (SVD) method. These two methods were applied to an x-ray spectral deconvolution problem having m channels of observations with n points in energy space. When m is less than n, this problem has no unique solution. We discuss the systematics of nonunique solutions and energy-dependent error bars for both methods. The Monte-Carlo approach has a particular benefit in relation to the SVD method: It allows us to apply the constraint of spectral nonnegativity after the SVD deconvolution rather than before. Consequently, we can identify inconsistencies between different detector channels.

32882 Diffusion-synthetic acceleration methods for discrete-ordinates problems. Larsen, E.W. (University of California, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Transport Theory and Statistical Physics;* **13**: No. 1, 107-126(Jan 1984).

The diffusion-synthetic acceleration (DSA) method is an iterative procedure for obtaining numerical solutions of discrete-ordinates problems. The DSA method is operationally more complicated than the standard source-iteration (SI) method, but if encoded properly it converges much more rapidly, especially for problems with diffusion-like regions. In this article we describe the basic ideas behind the DSA method and give a (roughly chronological) review of its long development. We conclude with a discussion which covers additional topics, including some remaining open problems an the status of current efforts aimed at solving these problems.

32883 **Nonlinear semigroup whose generator is not dissipative.** Busenberg, S.N.; Travis, C.C. (Harvey Mudd College, Claremont, CA). *Houston Journal of Mathematics;* 9: No. 3, 363-372(1983). Contract W-7405-ENG-26.

This paper provides an example of a nonlinear semigroup in a Hilbert space that arises naturally in the study of population diffusion and whose infinitesimal generator is not omega-dissipative. Nevertheless, this semigroup is related to its generator through the usual nonlinear exponential formula. 7 references.

70 FUSION ENERGY

7001 Plasma Research

REFER ALSO TO CITATION(S) 31769, 32067, 32068, 32502, 32859, 33067

32884 **(DOE/ER/03077—245) Some rigorous results concerning spectral theory for ideal MHD.** Laurence, P. (New York Univ., NY (USA). Courant Inst. of Mathematical Sciences). May 1985. Contract AC02-76ER03077. 46p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85013427.

Spectral theory for linear ideal MHD is laid on a firm foundation by defining appropriate function spaces for the operators associated with both the first and second order (in time and space) partial differential operators. Thus, it is rigorously established that a self-adjoint extension of $F(\xi)$ exists. It is shown that the operator L associated with the first order formulation satisfies the conditions of the Hille-Yosida theorem. A foundation is laid thereby within which the domains associated with the first and second order formulations can be compared. This allows future work in a rigorous setting that will clarify the differences (in the two formulations) between the structure of the generalized eigenspaces corresponding to the marginal point of the spectrum $\omega = 0$.

32885 **(DOE/ET/51017—T2) Symmetric Tandem Mirror program. Annual progress report.** (TRW Space and Technology Group, Redondo Beach, CA (USA). Energy Div.). 1985. Contract AC03-79ET51017. 56p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85012352.

The STM program was initiated in June 1979. The overall objective was to examine confinement of high-β plasmas in an axisymmetric mirror configuration which are stabilized by the presence of a plasma produced, annular magnetic well (ELMO-ring). To accomplish this objective, we chose to generate the high-β mirror-confined plasmas by ICRH. The annular wells result from diamagnetism of hot electrons generated by ECRH. The development of techniques for controlling the spatial and energy distributions of these electrons was an essential ingredient in our program. The culmination of this work is the successful generation of hot-ion plasmas by ICRH with anti n $\sim 1 \times 10^{13}$ cm^{-3} and T/sub i/ $\sim$ 300 eV corresponding to anti $\beta \cong 5\%$.

32886 **(DOE/ET/53051—79) Observation of helical sawtooth oscillations in a tokamak.** Brickhouse, N.S.; Osborne, T.H.; Dexter, R.N.; Prager, S.C. (Wisconsin Univ., Madison (USA). Dept. of Physics). Feb 1985. Contract AC02-76ET53051. 11p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85012062.

In the Tokapole II tokamak the three-dimensional structure of the rapid sawtooth crash which accompanies internal disruptions has been observed. The sawtooth crash is helical, i.e., the decrease in soft X ray intensity occurs along a $q = 1$ helical contour, in accord with the standard reconnection model. The poloidally asymmetric radial expansion of the crash inward from the $q = 1$ surface, provides a measure of the reconnection time consistent with single helicity reconnection from a growing, non-rotating magnetic island.

32887 **(DOE/ET/53072—T1) Application of nonlinear methods to some current problems in fusion plasma physics. Final report.** Treve, Y.M. (Treve (Yvain M.), Santa Barbara, CA (USA)). 26 Mar 1984. Contract AC03-78ET53072. 4p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85011579.

This is the final report of the work done on Contract ASO3-78ET53072, "Application of Nonlinear Methods to Some Current Problems in Fusion Plasma Physics". Most of the effort has been devoted to the problem of the reliability of numerical simulation of MHD flows. We also have studied some topological aspects of the period-doubling phenomenon for some forced nonlinear oscillators.

32888 **(DOE/ET/53088—177) Local conservation laws for the Maxwell-Vlasov and collisionless kinetic guiding center theories.** Pfirsch, D.; Morrison, P.J. (Texas Univ., Austin (USA). Inst. for Fusion Studies). Apr 1985. Contract FG05-80ET53088. 17p. (IFSR—177). NTIS, PC A02/MF A01; GPO Dep. File Number DE85013122.

Using one of the author's recent variational formulation of the Maxwell-Vlasov and guiding center theories, the energy-momentum and angular momentum tensors for such theories are derived and the corresponding local conservation laws are proven. The energy-momentum tensor is shown to be symmetric in its spatial components while the angular momentum density is naturally antisymmetric.

32889 **(DOE/ET/53088—179) Scale separation closure and Alfven wave turbulence.** Chen, C.Y.; Mahajan, S.M. (Texas Univ., Austin (USA). Inst. for Fusion Studies). Apr 1985. Contract FG05-80ET53088. 24p. (IFSR—179). NTIS, PC A02/MF A01; GPO Dep. File Number DE85013124.

Based on the concept of scale separation between coherent response function and incoherent source for renormalized turbulence theories, a closure scheme is proposed. A model problem dealing with shear-Alfven wave turbulence is numerically solved; the solution explicitly shows expected turbulence features such as frequency shift from linear modes, band-broadening, and a power law dependence for the turbulence spectrum.

32890 **(DOE/ET/53088—187) Current interruption by density depression.** Wagner, J.S.; Tajima, T.; Akasofu, S.I. (Texas Univ., Austin (USA). Inst. for Fusion Studies; Alaska Univ., Fairbanks (USA). Geophysical Inst.). Apr 1985. Contract FG05-80ET53088. 25p. (IFSR—187). NTIS, PC A02/MF A01; GPO Dep. File Number DE85013120.

Using a one-dimensional electrostatic particle code, we examine processes associated with current interruption in a collisionless plasma when a density depression is present along the current channel. Current interruption due to double layers was suggested by Alfven and Carlqvist (1967) as a cause of solar flares. At a local density depression, plasma instabilities caused by an electron current flow are accentuated, leading to current disruption. Our simulation study encompasses a wide range of the parameters in such a way that under appropriate conditions, both the Alfven and Carlqvist (1967) regime and the Smith and Priest (1972) regime take place. In the latter regime the density depression decays into a stationary structure ("ion-acoustic layer") which spawns a series of ion-acoustic "solitons" and ion phase space holes travelling upstream. A large inductance of the current circuit tends to enhance the plasma instabilities.

32891 **(DOE/ET/53088—190) High energy plasma accelerators.** Tajima, T. (Texas Univ., Austin (USA). Inst. for Fusion Studies). May 1985. Contract FG05-80ET53088. 144p. (IFSR—190). NTIS, PC A07/MF A01; GPO Dep. File Number DE85013121.

Colinear intense laser beams ω_0, κ_0 and ω_1, κ_1 shone on a plasma with frequency separation equal to the electron plasma frequency ω/sub pe/ are capable of creating a coherent large longitudinal electric field E/sub L/ = mc ω/sub pe//e of the order of 1GeV/cm for a plasma density of 10^{18} cm^{-3} through the laser beat excitation of plasma oscillations. Accompanying favorable and deleterious physical effects using this process for a high energy beat-wave accelerator are discussed: the longitudinal dephasing, pump depletion, the transverse laser diffraction, plasma turbulence effects, self-steepening, self-focusing, etc. The basic equation, the driven nonlinear Schroedinger equation, is derived to describe this system. Advanced accelerator concepts to overcome some of these problems are proposed, including the plasma fiber accelerator of various variations. An advanced laser architecture suitable for the beat-wave accelerator is suggested. Accelerator physics issues such as the luminosity are discussed. Applications of the present process to the current drive in a plasma and to the excitation of collective oscillations within nuclei are also discussed.

32892 (IA—1404, pp 53) **Non-local contribution to thermal transport.** Shvarts, D.; Bar-Noy, T. Jul 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85780940.

Published in summary form only.
In Research laboratories annual report 1983.

32893 (IA—1404, pp 55) **Stabilization of the Rayleigh-Taylor instability by a shaped ion beam.** Sapir, M.; Havazelet, D. Jul 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85780940.

Published in summary form only.
In Research laboratories annual report 1983.

32894 (IA—1404, pp 54) **Analytical model for creation and decay of strong shock waves caused by a trapezoidal laser pulse.** Loeb, A.; Eliezer, S. Jul 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85780940.

Published in summary form only.
In Research laboratories annual report 1983.

32895 (IA—1404, pp 58) **Experimental evidence of charge separation (double layer) in laser produced plasmas.** Ludmirsky, A.; Eliezer, S.; Arad, B.; Borowitz, A.; Gazit, Y.; Jackel, S.; Krumbein, A.D.; Szichman, H. Jul 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85780940.

Published in summary form only.
In Research laboratories annual report 1983.

32896 **(IPF—84-4) Four-fluid description of turbulent plasma focus dynamics.** Hayd, A.; Maurer, M.; Meinke, P.; Kaeppeler, H.J. (Stuttgart Univ. (Germany, F.R.). Inst. fuer Plasmaforschung). Jun 1984. 20p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85780962.

The dynamic phenomena in the compression, pinch and late phases of the plasma focus experiment POSEIDON in its operational mode at 60 kV, 280 kJ, were previously calculated from a two-fluid theory using the new hybrid code REDUCE/FORTRAN. Two important results were found: the neutron production already in the pinch phase for currents larger than 500 kA and filamentary structures on and around the pinch axis. In a continuation of this work, a four-fluid system of dynamical equations was formulated and programmed with the REDUCE/FORTRAN code. Besides macro-turbulence, the new four-fluid theory includes micro-instabilities and anomalous transport properties, as well as the runaway effect for electrons and ions. First results from calculations with this new theory are presented and are compared with previous calculations and with recent experimental observations.

32897 **(IPF—84-10) Two phases of neutron production in the Poseidon plasma focus.** Herold, H.; Bertalot, L.; Hirano, K.; Jaeger, U.; Kaeppeler, H.J.; Schmidt, H.; Schmidt, R.; Shakhatre, M.; Shyam, A.; Sadowski, M. (Stuttgart Univ. (Germany, F.R.). Inst. fuer Plasmaforschung). Sep 1984. 20p. (CONF-840910—26; IAEA-CN—44/D-III-6-3). NTIS (US Sales Only), PC A02/MF A01. File Number DE85780958.

From 10. international conference on plasma physics and controlled nuclear fusion research; London, UK (12 Sep 1984).

Various measurements performed in the 280 kJ, 60 kV operational mode of the Poseidon plasma focus confirm that at high pinch currents (approx.= 1 MA) there exist two phases of suprathermal neutron production. In the pinch phase, the neutron emission from a macroscopically smooth, relatively quiet thermal (Tsub(i) approx.= 1 k to 0.4 keV) plasma column is very likely caused by accelerated deuterons (<= 400 keV) trapped for up to 100 ns in the pinch by gyro-motion and relaxation. MHD calculations suggest that the acceleration may be due to an MHD-instability induced reconfiguration process, leading to current filamentation and high Bsub(z)-fields. In soft X-ray pictures filaments, particularly a central filament, were observed. Indications for Bsub(z)-fields were deduced from the directions of the reaction proton trajectories. The rather irreproducible, strong neutron production in the second phase is associated with m = 0 pinch break-ups and with fast deuterons accelerated mainly in axial direction.

32898 **(IPP—1/228) Proposed method for fast determination of plasma parameters.** Braams, B.J.; Lackner, K. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). Sep 1984. 17p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85751545.

32899 **(IPP—4/219) Second harmonic ion cyclotron resonance heating in ASDEX: Results of ray tracing calculations.** Steinmetz, K.; Brambilla, M. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). Jul 1984. 47p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85780956.

First ray tracing cumputations based on typical ASDE hydrogen plasma parameters are presented. It is shown that the heating efficiency is already appreciable for ohmically heated discharges, where, depending on density, 10 to 25% single transit absorption has been calculated. The efficiency strongly increases with electron density and plasma temperature reaching more than 40% single transit absorption at Tsub(io) = 3 keV, Tsub(eo) = 1.5 keV, nsub(eo) = 5 x 10^{13} cm^{-3}. Well defined power depositions profiles with peak power densities of a few W/cm^3 per MW and of small halfwidth are found to be rather insensitive to typically observed variations of plasma density and temperature profiles. In the temperature range explored so far most wave power is transferred to the plasma ions.

32900 **(IPP—6/235) Normal mode analysis for linear resistive magnetohydrodynamics.** Kerner, W.; Lerbinger, K.; Gruber, R.; Tsunematsu, T. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). Oct 1984. 56p. NTIS (US Sales Only), PC A04/MF A01. File Number DE85780951.

The compressible, resistive MHD equations are linearized around an equilibrium with cylindrical symmetry and solved numerically as a complex eigenvalue problem. This normal mode code allows to solve for very small resistivity eta proportional 10^{-10}. The scaling of growthrates and layer width agrees very well with analytical theory. Especially, both the influence of current and pressure on the instabilities is studied in detail; the effect of resistivity on the ideally unstable internal kink is analyzed.

32901 **(IPP—6/237) Fluctuation spectrum for linear gyroviscous MHD.** Caldas, I.L.; Tasso, H. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). May 1984. 9p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85780966.

The influence of gyroviscosity on the fluctuations of an MHD plasma is investigated. The main result is that gyroviscosity does not help to remove ultraviolet divergences. For a sub-class of observables it does not even show up. The full non-linear problem may be needed.

32902 **(IPP—6/241) Three-drift-wave interaction at finite parallel wavelength: Bifurcations and transition to turbulence.** Biskamp, D.; He Kaifen. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). Aug 1984. 32p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85780949.

The generic properties of the nonlinear interaction of three driftwaves with finite kappasub(parallel) are investigated. The different types of stationary or quasi-stationary states are characterized by the bifurcation diagram in γ_1, kappa parameter space, where γ_1 measures the mode excitation and kappa the parallel wave number. The transition to turbulence corresponds exactly to the Ruelle-

Takens picture: steady state -> periodic solution -> doubly periodic solution -> turbulence, in contrast to the periodic-doubling route usually observed in low-dimensional dynamic systems.

32903 (IPP—6/242) Resistive spectrum of configurations without magnetic shear. Lortz, D.; Spies, G. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). Aug 1984. 18p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85780950.

The problem of determining the normal modes of a slightly resistive, incompressible plasma slab with unidirectional fields is reduced to quadratures. The eigenfrequencies are on a system of curves in the stable part of the complex plane which are independent of the resistivity eta. For finite wave number the distance from the tip of the ideal Alfven continuum of the nearest eigenvalue is O(etasup(1/3)). The first correction to this is O(1/vertical strokeln etavertical stroke), which thus only becomes small for unrealistically small values of eta. Including this logarithmic correction yields quantitative agreement with numerical computations.

32904 (JAERI-M—84-047) Irradiation effects on components of spectroscopic measurement device for JT-60 diagnostics. Nishitani, Takeo; Sugie, Tatsuo; Tanaka, Ryuichi. (Japan Atomic Energy Research Inst., Tokyo). Mar 1984. 50p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. File Number DE85700992.

Irradiation effects on photomultiplier tubes, silicon photodiodes, electronics, glass plates, mirrors, gratings and optical glasses, which are components of spectroscopic measurements for JT-60 diagnostics, are investigated. They are exposed by γ-rays at exposure rate 10^2 up to 10^5 R/h and optical glasses are irradiated by neutrons at about 10^{12} n/cm^2. Photomultipliers and silicon photodiodes have undesirable large efficiencies for γ-ray detection, and the former's dark currents increase by irradiation. An analog circuit operates normally under the γ-ray exposure rate up to 10^5 R/h, but a counter device in the digital circuit are broken down at exposure rate 10^5 R/h. No irradiation effect is found in mirrors and gratings after 4 x 10^4 R exposure. In irradiation experiments of γ-rays and neutrons, nonbrown glasses are not colored.

32905 (LA-UR—85-1789) Increased particle confinement with the use of external dc bias field in the CTX spheromak. Barnes, C.W.; Hoida, H.W.; Henins, I.; Fernandez, J.C.; Jarboe, T.R.; Marklin, G.J. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 6p. (CONF-8505100—5). NTIS, PC A02/MF A01; GPO Dep. File Number DE85012744.

From 7. US symposium on compact toroid research; Santa Fe, NM, USA (21 May 1985).

Spheromaks are formed in a mesh flux conserver in the presence of an external dc bias field. The spheromaks remain stable to tilt instabilities with ratios of bias-to-spheromak flux of up to 47 +- 7%. Normally applied bias flux puts the spheromak separatrix inside the metal mesh and improves the particle confinement.

32906 (N—85-18747) Coordinated research program at IAEA on atomic collision data for plasma diagnostics. Itikawa, Y. (Institute of Space and Astronautical Science, Tokyo (Japan)). Nov 1984. 5p. NTIS, PC A07/MF A01.

Evaluated data sets of atomic collision data were generated in accordance with requirement priorities determined by the fusion community were generated. The collision processes the highest priority are: (1) electron impact excitation of ions; (2) electron impact ionization of the ions; and (3) charge exchange, and related processes like dielectronic recombination, ion impact ionization. The current status of the relevant data and recommendations are presented. It is recommended that cross sections for collision processes are used for diagnositcs and plasma modeling.

32907 (N—85-18772) Energy spectra of slowed-down neutrals from the heating beams in ASDEX. Notermans, G.H.J. (FOM-Instituut voor Plasmafysica, Jutphaas (Netherlands)). Jul 1984. 29p. (REPT—84-157). NTIS, PC A03/MF A01.

Measurements of the slowing-down spectrum of the ASDEX Tokamak heating beam are compared with predictions based on a numerical solution of the Fokker-Planck equation in a two-dimensional velocity space. The result is used to evaluate the charge exchange spectrum of confined beam particles, emerging from the plasma under various angles with respect to the magnetic field. This flux is compared with the yield stemming from direct scattering of the neutral beam particles on the plasma ions. (ESA)

32908 (N—85-18775) Improved directional couplers for overmoded waveguide systems. Janzen, G.; Stickel, H. (Stuttgart Univ. (Germany, F.R.)). Jan 1984. 15p. (IPF—84-1). NTIS, PC A02/MF A01.

Directional couplers for waveguides used in plasma heating of thermonuclear fusion devices were tested: TE11 coupler, 28 GHz, 40 mm dia TE11, 70 GHz 27.79 mm TE02, 60 GHz, 63.4 mm and TE03, 28 GHz, 63.4 mm. Multihole couplers showing insufficient suppression of single modes or insufficient directivity can be improved by adding holes of a shifted coupler structure of the same kind. A shifted structure improving the directivity also enhances suppression of unwanted modes propagating in backward direction. Marked suppression of a single unwanted backward mode also improves suppression of the other backward modes as well as directivity. Marked suppression of an unwanted mode in forward direction with very similar phase velocity to the desired mode can be problematic, because the desired mode amplitude may be considerably reduced by this measure. (ESA)

32909 (N—85-18776) Four phase model for turbulent instabilities calculation in plasma jets. Hayd, A.; Kaeppeler, H.J.; Haurer, M.; Meinke, P. (Stuttgart Univ. (Germany, F.R.)). Mar 1984. 22p. (In German). (IPF—84-2). NTIS, PC A02/MF A01.

A two phase theory which describes the plasma compression, pinch and decay phase for the plasma generator POSEIDON in the range 280 kJ, 60 kV is presented. The REDUCE/FORTRAN hybricode calculation was made. This shows neutron production in the pinch phase. For dynamic calculation of the plasma jet, a four phase theory was derived to cope with macro and microturbulence. The results of both calculations were compared to experimental observations on POSEIDON. (ESA)

32910 (N—85-18777) Lidar-Thomson scattering. Final report, 15 June 1984. Brederlow, G.; Gruber, J.E.; Hirsch, K.; Roehr, H. (Stuttgart Univ. (Germany, F.R.)). Jun 1984. 155p. (IPF—84-3; IPP—1/299). NTIS, PC A08/MF A01.

A lidar-Thomson scattering system was designed for the Joint European Torus. Spatial resolution of 12 cm is achieved using an iodine laser (15 J at 657 nm, 300 psec pulse duration) with microchannel plate photomultipliers and a 1 GHz oscilloscope. The statistical errors of the electron temperature and density measurements for a 5 channel spectrometer with a dynamic range of 0.7 to 15 keV are smallest at 5 keV (2.6%). The feasibility of 1 Hz operation over a sequence of 10 shots is demonstrated. The design of a 15 J frequency-doubled laser system is considered. The stray light level to be expected was determined in a full scale optical set-up with a low energy, frequency doubled iodine laser. It is shown that stray light constitutes no problem for the Thomson scattering experiments due to the good gating properties of the detector. Even Rayleigh scattering measurements for absolute calibration at 1 Torr hydrogen filling pressure should be possible. (ESA)

32911 (NRCN—518) Implication of various confinement laws on solutions of steady self-burning plasma in Tokamaks. Sapir, M. (Israel Atomic Energy Commission, Beersheba. Nuclear Research Center-Negev). Jun 1983. 57p. NTIS (US Sales Only), PC A04/MF A01. File Number DE85701433.

The behavior of the steady state parameters for self-sustained burning plasma in tokamak reactors was investigated on the basis of various confinement laws. The studies included the trapped-ion-mode, the trapped-electron-modes, the pseudoclassical confinement law, empirical confinement laws and laws with a range of constant confinement times. Specifically, the generated power and refueling rate behavior was determined as a function of temperature and magnetic field for the various confinement laws. Since these solutions can be found only in a limited range of parameters, it is of interest to determine this domain and study its dependence on geometry. In particular the minimum magnetic field which is necessary to achieve a steady self-sustained burning plasma was found as a function of its minor radius and consequently some parameters are suggested for small size tokamak reactors.

32912 **(ORNL/TM—8938) Langmuir probe on ISX-B.** Wootton, A.J.; Yokoyama, K.E.; Edmonds, P.H. (Oak Ridge National Lab., TN (USA)). May 1985. Contract AC05-84OR21400. 22p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85012066.

The procedures used to derive temperature and density with a floating probe are documented. The accuracy of a Fourier analysis with restricted terms and the importance of various correction terms in calculating the density from the saturation current are discussed. Methods of reducing errors introduced by circuit resistance and fluctuations are presented.

32913 **(ORNL/TM—9372) Multiple-frequency electron cyclotron heating of hot electron rings in EBT-I.** Rasmussen, D.A.; Bigelow, T.S.; Batchelor, D.B.; Hillis, D.L.; Haste, G.R.; Quon, B.H.; Hankins, O.E. (Oak Ridge National Lab., TN (USA)). May 1985. Contract AC05-84OR21400. 22p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85011302.

The use of multiple-frequency microwave power for electron cyclotron heating (MFECH) significantly increased the ring stored energy in the SM-1 simple mirror device. MFECH was used on ELMO Bumpy Torus (EBT) in an effort to increase its hot electron beta. No substantial improvement in the ring parameters was observed in a series of two-frequency ECH experiments, with frequency separations up to 90 MHz, in contrast to the dramatic improvement found in the axisymmetric SM-1 experiment. The absence of superadiabatic behavior by the energetic electrons, combined with the effects of reduced heating efficiency and the additional ring losses introduced by the canting of the EBT mirror sectors, appears to limit the hot electron ring beta.

32914 **(ORNL/TM—9397) Instrument to synchronize Thomson scattering diagnostic measurements with MHD activity in a tokamak.** Wintenberg, A.L. (Oak Ridge National Lab., TN (USA)). Apr 1985. Contract AC05-84OR21400. 139p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE85012082.

An instrument to synchronize the firing of a ruby laser for a Thomson scattering diagnostic with plasma oscillations was designed, developed, and evaluated. The instrument will fire the laser at a user-selected phase of an input sine or sawtooth wave with an accuracy of +-15°. Allowable frequencies range from 20 to 500 Hz for a sawtooth and from 1 to 30 kHz for a sine wave. The instrument also allows synchronization with a sine wave to be enabled by a preselected sawtooth phase. The instrument uses analog signal processing circuits to separate the signal components, remove unwanted components, and produce zero-phase synchronization pulses. The instrument measures the period between zero-phase pulses in order to produce phase synchronization pulses delayed a fraction of the period from the zero-phase pulses. The laser is fired by the phase synchronization pulse. Unwanted signal components are attenuated by bandpass filters. A digitally controlled self-adjusting bandpass filter for sine processing. The instrument was used to investigate the variation of the electron temperature profile with the phase of the x-ray signal from an Impurity Studies Experiment (ISX-B) plasma exhibiting magnetohydrodynamic (MHD) activity.

32915 **(ORNL/TM—9399) High-field launch electron cyclotron heating experiments in the ELMO Bumpy Torus.** Rasmussen, D.A.; Batchelor, D.B.; Swain, D.W.; White, T.L.; Kimrey, H.D.; Bigelow, T.S.; Cobble, J.A.; Hillis, D.L.; Richards, R.K.; Uckan, T. (Oak Ridge National Lab., TN (USA)). May 1985. Contract AC05-84OR21400. 46p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85012068.

The midplane microwave heating system in the ELMO Bumpy Torus (EBT) was supplemented with power launched from the high-field side of the fundamental resonance by an antenna in the magnet coil throat. Up to 43 kW of polarized (extraordinary mode), 28-GHz power was successfully launched with one antenna. Measurements were made of changes in the core and hot electron ring plasma parameters when throat-launch power was added. In sharp contrast to initial expectations, the bulk core plasma parameters were degraded while the ring parameters, in the launch cavity, were improved. These results are explained in light of a modified picture of electron cyclotron heating (ECH) in EBT. A picture of localized microwave absorption and particle losses is supported by additional measurements.

32916 **(PPPL—2209) Transformation of Hamiltonians to near action-angle form.** Boozer, A.H. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Apr 1985. Contract AC02-76CH03073. 13p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85011279.

A classical Hamiltonian would be solved by a transformation to action-angle variables I,θ in which the Hamiltonian is H-bar(I). Generally, such a transformation does not exist, and, at best, the Hamiltonian can be transformed to H-bar(I) + H(I,θ,t) with H being a sum of Fourier terms that resonate with H-bar. We give a set of ordinary differential equations in a parameter ϵ that carry out this transformation as the set is integrated from ϵ equal to zero to one. Although the differential equations can be integrated numerically, approximations give classical perturbation theory.

32917 **(PPPL—2211) Viscous current drive.** Stix, T.H.; Ono, M. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Apr 1985. Contract AC02-76CH03073. 12p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85011739.

It is suggested that electron viscosity associated with magnetic turbulence be used to control the current profile or to drive steady-state current in a tokamak. Due to the strongly asymmetric character of the onset condition for an instability such as the double-tearing mode, rapid radial penetration will occur only for properly directed incremental current. This penetration can be modelled by adding a new term to Ohm's law, one which represents the mean-field behavior of the instability-associated turbulence by an anomalous shear viscosity for parallel electron flow.

32918 **(RAL—84-086) Relativistic saturation of 'beat waves'.** Evans, R.G. (Rutherford Appleton Lab., Chilton (UK)). Sep 1984. 15p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700991.

Large amplitude Langmuir waves with a phase velocity close to the speed of light may be generated by the beat frequency of two co-propagating laser waves in an underdense plasma. Numerical simulations of the saturation of these waves show that relativistic detuning limits the wave growth but fails to give quantitative agreement with earlier work. Reasons for this disagreement are discussed and the numerical work is found to agree with more recent calculations.

32919 **(SAIC—85/1676-PRI-91) RF stabilization of interchange-ballooning modes.** Myra, J.R.; D'Ippolito, D.A. (Science Applications International Corp., Boulder, CO (USA). Plasma Research Inst.). Apr 1985. Contract AC03-76ET53057. 13p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85012080.

A fully electromagnetic theory describing the interaction of radio frequency waves with low frequency curvature driven modes in mirror geometry is presented. The theory includes the direct ponderomotive force terms and sideband mode coupling on an equal footing. Tandem mirror stabilization experiments are discussed with emphasis on what further measurements would enable a more definitive comparison of theory and experiment.

32920 **(UCID—20400) User's manual for the FLORA equilibrium and stability code.** Freis, R.P.; Cohen, B.I. (Lawrence Livermore National Lab., CA (USA)). 1 Apr 1985. Contract W-7405-ENG-48. 22p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85013182.

This document provides a user's guide to the content and use of the two-dimensional axisymmetric equilibrium and stability code FLORA. FLORA addresses the low-frequency MHD stability of long-thin axisymmetric tandem mirror systems with finite pressure and finite-larmor-radius effects. FLORA solves an initial-value problem for interchange, rotational, and ballooning stability.

32921 **(UCID—20405) Physics modeling of tandem mirror devices with high-field test cell inserts.** Fenstermacher, M.E.; Campbell, R.B. (TRW, Inc., Redondo Beach, CA (USA); Lawrence Livermore National Lab., CA (USA)). 15 Apr 1985. Contract W-7405-ENG-48. 64p. NTIS, PC A04/MF A01; GPO Dep. File Number DE85011870.

Recently developed plasma physics models of tandem mirror operation with a high-field technology test cell insert in the central cell are described in detail. These models have been incorporated in the TMRBAR tandem mirror reactor physics code. Results of a benchmark case for the code models against previous analysis of the MFTF - α^{+} T configuration are given. A brief users guide to the new TMRBAR with the test cell models is also presented. Some description of the applications of the models to MFTF - α^{+} T and FPD - II + T configurations is made. References are given to separate reports on these studies.

32922 **(UCRL—92532) Perspective on the next ten years in plasma physics.** Killeen, J. (Lawrence Livermore National Lab., CA (USA)). Apr 1985. Contract W-7405-ENG-48. 11p. (CONF-8503105—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85011849.

From Orbital dynamics and applications to accelerators workshop; Berkeley, CA, USA (7 Mar 1985).

A brief survey of developments in the plasma physics of magnetic fusion research is presented. The major experimental facilities of the next decade are listed. Eight fusion physics issues are identified which must be addressed as a complete plasma system in order to reach the goal of a fusion reactor. In order to resolve the physics issues the results from these new experimental facilities must be augmented by an extensive program of computer modeling. The use of computer models of a magnetically confined plasma and the implementation of these models on the new supercomputers of the next decade are the main topics of this paper.

32923 **Energy and density measurements of sloshing ions in tandem-mirror-experiment upgrade using solid-state probe techniques.** Hsu, W.L.; Bastasz, R.; Wampler, W.R.; Rensink, M.E.; Allen, S.L.; Grubb, D.P.; Simonen, T.C. (Sandia National Laboratories, Livermore, California 94550). *Journal of Applied Physics;* **58**: No. 1, 179-183(1 Jul 1985).

The energy and flux of charge-exchange neutrals from the sloshing ions in the endplug of tandem-mirror-experiment upgrade were measured using solid-state probes. An average energy of the sloshing ions of 6 keV was inferred from the depth profile of deuterium implanted in a silicon sample exposed to the charge-exchange neutrals. A bounce-averaged Fokker—Planck code was used to calculate the sloshing-ion energy distribution. The calculated depth profile of deuterium in the silicon sample resulting from this energy distribution is in good agreement with the measured profile. Carbon resistance probes were used to measure the charge-exchange flux from which the central chord sloshing-ion line density was inferred. The line density of particles with energies$>$2 keV was deduced to account for 60% of the total plasma line density in the endplug. By folding the sloshing-ion line density into the diamagnetic loop data, it was shown that the 1/e radial extent of the sloshing ions remained relatively constant from shot to shot at 14 cm.

32924 **Electron heating by waves in the ion-cyclotron frequency range.** Fruchtman, A. (Courant Institute of Mathematical Sciences, New York University, New York, New York 10012). *Physics of Fluids;* **28**: No. 7, 2188-2193(Jul 1985). Contract AC02-76ER03077.

The interaction between waves in the ion-cyclotron frequency range and a hot-electron ring is studied. The configuration is approximated by a slab geometry in which the hot-electron ring is a few Larmor radii thick, the confining magnetic field is uniform, and the hot-electron distribution function is anisotropic. The wave vector of the incident wave is nearly perpendicular to the magnetic field with a small parallel component, so that both parallel streaming and finite Larmor radius effects are present. It is shown that a significant part of the energy flux may be absorbed by the electrons in a single pass of the wave through the ring. This process may be responsible for the electron ring heating observed in the Elmo Bumpy Torus-S [Nucl. Fusion 23, 49 (1983)] recently. Numerical results of energy absorption and wave transmission are presented for a wide range of parameters. For two special cases, the Born approximation and finite Larmor radius expansions enable us to simplify the analysis. The energy absorption calculated under the approximations is compared with the more exact treatment.

32925 **Numerical simulations of current-limited double layers observed in a linear mirror device.** Inuzuka, H.; Torii, Y.; Tsukishima, T. (Faculty of Engineering, Nagoya University, Nagoya 464, Japan). *Physics of Fluids;* **28**: No. 7, 2106-2115(Jul 1985).

Simulations based on the Vlasov—Poisson scheme are carried out to observe the temporal and spatial development of dopuble layers (DLs) in a linear mirror field. Simulation results show that the magnetic mirrors have a substantial effect in reducing the current passing through the DL. Development of a negative potential region on the low potential side of the DL is also observed, in agreement with the experimental results. The observed strong DLs appear to be formed, triggered by the ion-acoustic instability.

32926 **Theory of resistivity-gradient-driven turbulence.** Garcia, L.; Diamond, P.H.; Carreras, B.A.; Callen, J.D. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physics of Fluids;* **28**: No. 7, 2147-2158(Jul 1985).

A theory of the nonlinear evolution and saturation of resistivity-driven turbulence, which evolves from linear rippling instabilities, is presented. The nonlinear saturation mechanism is identified both analytically and numerically. Saturation occurs when the turbulent diffusion of the resistivity is large enough so that dissipation caused by parallel electron thermal conduction balances the nonlinearly modified resistivity gradient driving term. The levels of potential, resistivity, and density fluctuations at saturation are calculated. A combination of computational modeling and analytic treatment is used in this investigation.

32927 **Simulation of the ion-beam-driven drift instability in a magnetic trap. I.** Thomas, V.A.; Nevins, W.M.; Chen, Y.J. (Electronics Research Laboratory, University of California, Berkeley, California 94720). *Physics of Fluids;* **28**: No. 7, 2235-2247(Jul 1985).

Recent experiments on the TMX-U device, at the Lawrence Livermore National Laboratory have indicated the possibility of a drift wave being driven unstable by the injection of neutral beams in the thermal barrier region. A review of linear theory is presented in the local approximation. In addition, particle simulations are used to understand the nonlinear characteristics of this instability. The particle simulations are performed using 1d-3v and 2d-3v electrostatic particle simulation codes. The instability is shown to saturate by beam trapping, nonlinear electron effects, and nonlinear motion parallel to the density gradient. Resonant E x B motion is a significant process for some of the beam particles. This process is closely associated with the trapping of beam ions. Harmonic generation is also observed, as appears in some of the experimental data. Qualitative nonlinear theory is presented in support of the particle simulations.

32928 **Nonlinear resistive helical states in reversed-field pinches.** Dagazian, R.Y. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physics of Fluids;* **28**: No. 7, 2209-2218(Jul 1985).

Time-independent nonlinear states resulting from resistive modes with helical symmetry are shown to exist in reversed-field pinch configurations. The importance of flow effects in such states is demonstrated, and the nonlinear redistribution of magnetic flux caused by the presence of the deformation is discussed.

32929 **Microstability properties of the sheath region of a field-reversed configuration.** Gladd, N.T.; Sgro, A.G.; Hewett, D.W. (JAYCOR, San Diego, California 92138). *Physics of Fluids;* **28**: No. 7, 2222-2234(Jul 1985).

An analysis of the microstability properties of the sheath region of a field-reversed configuration is performed. Attention is focused on the lower-hybrid-drift instability, a mode known to be important in devices with similar parametric conditions. This mode is thought to play a significant role in determining the confinement properties of a field-reversed configuration. Specifically, a model profile characteristic of the sheath region is constructed and analyzed in detail, both theoretically, by means of a nonlocal kinetic theory, and computationally, by means of a hybrid simulation technique. The lower-hybrid-drift is found to be unstable under typical sheath conditions. The theoretically predicted growth rate and the variation of the growth rate with wavenumber is found to be in good agreement with the growth characteristics deduced from the simulation. By means of the hybrid simulation technique, the lower-hybrid-drift has been simulated at drift velocities as low as 0.2v/sub i/ with m/sub i//m/sub e/ = 100 and 0.3v/sub i/ with m/sub i// m/sub e/ = 3672.

32930 Characterization of laboratory plasmas with probes. Manos, D.M. (Princeton Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08544). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **3**: No. 3, 1059-1066(May 1985).

This paper presents a broad overview of various types of probes employed to study plasmas produced in laboratory environments. Methods reviewed include single, double, and triple Langmuir probes, biased calorimeters, E x B, RFA, momentum discriminating, and sample exposure probes.

32931 Plasma-edge studies using carbon resistance probes. Wampler, W.R. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **3**: No. 3, 1067-1073(May 1985). Contract AC04-76DP00789.

Characterization of erosion and hydrogen-recycling processes occurring at the edge of magnetically confined plasmas requires knowledge of the energy and flux of hydrogen isotopes incident on the materials. A new plasma-edge probe technique, the carbon resistance probe, has been developed to obtain this information. This technique utilizes the increase in electrical resistance caused in thin carbon films by energetic particle bombardment to characterize the flux and energy of the incident ions and neutrals. The method is relatively easy to implement and gives data in real time. Energy resolution of low dose exposures has been achieved using thin insulating films over the carbon. Calibrations using ion implantation show that the particle energies and fluxes which can be measured with resistance probes are well matched to those typically encountered near the wall in plasma devices. This paper describes the experimental technique and the model used to relate the measured resistance changes to the energy and flux of particles. Experiments are then described in which resistance probes were used to study energetic particles in the PLT and TEXTOR tokamaks and the TMX-U tandem mirror.

32932 Far-infrared laser scattering in the ACT-I toroidal device. Goree, J.; Mansfield, D.K.; Ono, M.; Wong, K.L. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08544). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **3**: No. 3, 1074-1076(May 1985). Contract AC02-76CH03073.

A far-infrared laser scattering diagnostic has been built for the ACT-I toroidal device. The optical system uses a passively stabilized 447-μm CH_3I laser. A polyethylene etalon is the beam splitter. The vacuum windows are plastic (TPX), which we found has the vacuum property Q 6.5 x 10^{-9} Torr l/s/cm^2. Using paraboloidal and ellipsoidal mirrors for detection optics improves the signal strength and allows a better rf enclosure design for the detector. The diagnostic was tested by scattering from an ion Bernstein wave, a technique which can be used for ion temperature diagnostics.

32933 Simulation of bent crystal spectrometers. Kyrala, G.A. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Review of Scientific Instruments;* **56**: No. 5, 815-817(May 1985).

In crystal spectrometers one traditionally labels each position in the dispersion/recording plane by a single wavelength value. A simple examination of the crystal spectrometers shows that different areas of the crystal contribute different wavelengths at the same position in the recording plane. Using collimators and apertures one may reduce these effects, as well as reduce the collected signal. Convolving the system response, in that case, may not allow simple analytic estimates of the sensitivity/responsivity of the system. A Monte-Carlo ray-trace program was written in order to study and simulate the real geometry including finite-source size effects. The results of the code are presented, demonstrating the contributions to the resolution and absolute responsivity, for a particular parabolically bent crystal spectrometer.

32934 Ultrafast turnoff laser triggered gating system for microchannel-plate intensified x-ray spectrometers. Christie, D.J.; Nilson, D.G.; Wiedwald, J.D.; Wilcox, R.B. (University of California, Lawrence Livermore National Laboratory (LLNL), P. O. Box 5508, Livermore, California 94550). *Review of Scientific Instruments;* **56**: No. 5, 818-820(May 1985).

A laser triggered photoconductive switch based microchannel-plate (MCP) gating system has been developed. The gating pulse provided to the MCP has a fall time on the order of 200 ps. Use of this system has resulted in increased signal-to-noise ratio on three MCP intensified x-ray spectrometers during recent x-ray experiments at the Novette laser facility. The x-ray signals of interest have a duration of approximately 300 ps while background in the same spectral region continues for several nanoseconds. As a result, signal-to-noise ratio is maximized by turning the MCP off just after the signals of interest are recorded. The MCP's are turned on by charging to approximately 1 kV with a slow rise-time (500 ns) pulse and rapidly gated off by a photoconductive switch connected to the MCP through transmission lines. Staggering the turnoff times of three microstrip lines across the MCP by 250 ps provides some time resolution. Details of the system, including pulse charging system, trigger beam delivery optics, and system diagnostics will be discussed.

32935 Time-integrated x-ray measurements of the very energetic electron end loss profile in TMX-U. Osher, J.E.; Fabyan, J. (Lawrence Livermore National Laboratory, University of California, Livermore, California 94550). *Review of Scientific Instruments;* **56**: No. 5, 824-826(May 1985).

The time-integrated 2D profile of the thick-target bremsstrahlung produced by energetic end loss electrons has been measured during electron cyclotron resonance heating (ECRH) operation of TMX-U. Sheets of x-ray film and/or arrays of thermoluminescent dosimeters were placed on the outside of the end tank end wall to measure the relative spatial x-ray profile, with locally added filters of Pb to determine the effective mean x-ray energy. The purpose of this simple survey diagnostic was to allow deduction of the gross features of the ECRH region. The electron source functions needed to fit the x-ray data were modeled for various anchor cell radial distributions mapped along magnetic field lines to the elliptical plasma potential control plates or the Al end walls. The data are generally consistent with (1) major ECR heating in the central 25-cm-diameter core, (2) a mean ECRH electron-loss energy of 420 keV, and (3) and ECRH coupling efficiency to these hot electrons of > or =10%.

32936 Fast multichannel electron temperature diagnostic for TFTR using x-ray imaging. Kiraly, J.; Bitter, M.; Goeler, S.v.; Hill, K.W.; Johnson, L.C.; McGuire, K.; Sesnic, S.; Sauthoff, N.R.; Tenney, F.; Young, K.M. (Princeton University, Plasma Physics Laboratory, Princeton, New Jersey 08544). *Review of Scientific Instruments;* **56**: No. 5, 827-829(May 1985).

The TFTR x-ray imaging system (XIS) is an array of 64-Si surface barrier diodes which image the plasma poloidally. Special absorber foils have been installed to permit measurement of electron temperature T/sub e/ with <100-μs time resolution along 10—30 chords. The technique uses the ratio of x-ray fluxes transmitted through two different foils, which depend mainly on T/sub e/. Simulations show that strong line radiation can change this ratio. To correct for these effects, special beryllium—scandium filters are employed to select the line-free region between 2 and 4.5 keV. Separate filter pairs allow correction for strong L line radiation as well as Ti or Ni Kα emission. The T/sub e/ determination is based on simulations. Comparison of results with T/sub e/ values from the electron—cyclotron emission and x-ray pulse height analysis diagnostics is presented.

32937 **Microchannel plate streak camera.** Wang, C.L.; Medecki, H.; Hale, C.P.; Leipelt, G.R.; Thomas, S.W.; Wiedwald, J.D. (Fusion Experiments Program, Lawrence Livermore National Laboratory, P. O. Box 5508, Livermore, California 94550). *Review of Scientific Instruments;* **56**: No. 5, 835-836(May 1985).

The development of a streak camera using a microchannel plate electron multiplier as the cathode is presented. Potential applications to γ-rays, low-energy x-rays, and charged particles are described. Preliminary test shows that 150-ps resolution can be obtained.

32938 **Tokamak Fusion Test Reactor horizontal high-resolution Bragg x-ray spectrometer (abstract).** Hill, K.W.; Bitter, M.; Tavernier, M.; Diesso, M.; von Goeler, S.; Johnson, G.; Johnson, L.C.; Sauthoff, N.R.; Schechtman, N.; Sesnic, S.; Tenney, F.; Young, K.M. (Princeton University, Plasma Physics Laboratory, Princeton, New Jersey 08544). *Review of Scientific Instruments;* **56**: No. 5, 848-848(May 1985).

A bent quartz-crystal spectrometer of the Johann type with a spectral resolution of $\lambda/\Delta\lambda = 10000—25000$ is used on the Tokamak Fusion Test Reactor (TFTR) to determine central plasma parameters from the spectra of helium-like and lithium-like metal impurity ions (Ti, Cr, Fe, and Ni). The spectra are observed along a central radial chord and are recorded by a position-sensitive multiwire proportional counter with a spatial resolution of 250 μ. Standard delay-line time-difference readout is employed. The data are histogrammed and stored in 64 K of memory providing 128 time groups of 512-channel spectra. The central ion temperature and the toroidal plasma rotation are inferred from the Doppler broadening and Doppler shift of the Kα lines. The central electron temperature, the distribution of ionization states, and dielectronic recombination rates are obtained from satellite-to-resonance line ratios. The performance of the spectrometer is demonstrated by measurements of the Ti XXI Kα radiation.

32939 **Study of impurity radiation on the PLT and TFTR tokamaks with high-resolution, time-resolving spectrometers.** Wouters, A.W.; Schwob, J.L.; Suckewer, S.; Boody, F.P.; Hulse, R.; Schivell, J. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08544). *Review of Scientific Instruments;* **56**: No. 5, 849-851(May 1985).

Soft-x-ray (5—300 A) spectra of intrinsic impurities have been recorded with a high-resolution multichannel XUV spectrometer (SOXMOS). Measurements of line intensity ratios as a function of time are applied to the determination of the impurity contribution to the energy balance. Results from TFTR Ohmic heated plasmas, including radiation due to carbon, oxygen, iron, nickel, chromium, titanium, and zirconium, are presented. The spatial ion distribution will be directly observed by a radial scanning spectrometer (FLOPSY). This instrument, under construction, will cover the spectral range from 1500 to 7000 A and use mirrors and lenses for fast scanning. The spatial ion distribution, deduced from forbidden and allowed lines, will be compared to both theoretical models based on impurity concentrations and transport coefficients, as well as experimental data from bolometer measurements.

32940 **Magnetic field measurements based on the Zeeman splitting of forbidden transitions.** Seely, J.F.; Feldman, U.; Sheeley N.R. Jr.; Suckewer, S.; Title, A.M. (E. O. Hulburt Center for Space Research, Naval Research Laboratory, Washington, D.C. 20375-5000). *Review of Scientific Instruments;* **56**: No. 5, 855-856(May 1985).

The measurement of the poloidal magnetic field in a tokamak plasma from the Zeeman splitting and polarization of the magnetic dipole radiation from heavy ions is discussed. When viewed from a direction perpendicular to the toroidal field, the effect of the poloidal field on the circularly polarized radiation is detectable using a photoelectric polarimeter.

32941 **Charge exchange recombination spectroscopy measurements of ion temperature and plasma rotation in PBX.** Jaehnig, K.P.; Fonck, R.J.; Ida, K.; Powell, E.T. (Princeton University, Plasma Physics Laboratory, Princeton, New Jersey 08544). *Review of Scientific Instruments;* **56**: No. 5, 865-867(May 1985).

The primary diagnostic on PBX for ion temperature measurements is charge exchange recombination spectroscopy of low Z ions, wherein fast neutrals from the heating neutral beams excite spectral lines from highly excited states ($n>4$) of hydrogenic O, C, and He via charge exchange collisions with the respective fully stripped ions. Since the neutral beams on PBX provide relatively low-velocity neutrals (i.e., D^0 beams at 44 keV), best signals are obtained using the near-UV lines of O^{7+} (e.g., $n = 8—7$, 2976 A). Off-line analysis of the Doppler broadened and shifted line profiles includes nonlinear least-squares fitting to a model line profile, while a simplified on-line fast analysis code permits between-shot data analysis.

32942 **Four-frame holographic probing system for plasma density measurement (invited).** Busch; Shepard, C.L.; Siebert, L.D.; Tarvin, J.A. (KMS Fusion, Inc., 3621 South State Road, P. O. Box 1567, Ann Arbor, Michigan 48106-1567). *Review of Scientific Instruments;* **56**: No. 5, 879-884(May 1985).

An important upgrade of UV holographic interferometry is now in use. Many hundreds of laser fusion-type target plasmas have been probed at KMS Fusion, Inc. using the holographic technique. The data obtained with this diagnostic include high-resolution images and plasma electron density distributions at various probe times. The diagnostic system now produces a sequence of four interferograms of an evolving plasma. The times of the 20-ps pulses in the sequence are fully adjustable and known within 10 ps. The experiments to which this diagnostic has been adapted will be described along with details of problems and their solutions. Selected sets of recent interferograms of plasmas produced by irradiation of thin foils will be presented along with their inversions.

32943 **Charge exchange recombination spectroscopy as a plasma diagnostic tool (invited).** Fonck, R.J. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08544). *Review of Scientific Instruments;* **56**: No. 5, 885-890(May 1985).

Intensity and line profile measurements of the spectra of light hydrogenic ions which are excited by charge exchange reactions with fast neutral atoms are being widely used as diagnostics for fusion plasma research. This technique, which is referred to as charge exchange recombination spectroscopy, allows measurements of the densities of fully stripped impurity ions and particle transport coefficients with only minor uncertainties arising from atomic processes. The excitation of long-wavelength transitions in light ions such as He^+, C^{6+}, and O^{7+} allows relatively easy measurements of ion velocity distributions to determine ion temperatures and plasma rotation velocities. Among its advantages for such measurements are the facts that fiber-optic coupling between a remote spectrometer and the immediate reactor environment is possible in many cases, the measurement is localized by the intersection region of a neutral beamline and viewing sightline, and intrinsic ions can be used so that injection of potentially perturbing impurities can be avoided. A particularly challenging application of this technique lies in the diagnosis of alpha particles expected to be produced in the present generation of Qroughly-equall tokamak experiments.

32944 **Electron cyclotron emission diagnostics for mirror devices (invited).** Ellis, R.F.; James, R.A.; Lasnier, C.J.; Casper, T. (University of Maryland, College Park, Maryland 20742). *Review of Scientific Instruments;* **56**: No. 5, 891-895(May 1985).

Electron cyclotron emission (ECE) has proven to be a useful diagnostic in tokamaks for measuring T/sub e/ and its radial variation. The application of ECE to mirror devices is discussed here, with emphasis on measurements of the properties of energetic electrons in tandem mirror end cells, which can be viewed both parallel and perpendicular to B. The parallel or whistler view is generally optically thick and can yield a measurement of perpendicular temperature. High harmonic perpendicular emission is optically thin and can yield important information about the hot electron buildup and the energy and spatial distribution. Experimental results from TMX-U and appropriate modeling are presented.

32945 **Far-infrared imaging of tokamak plasma.** Young, P.E.; Luhmann N.C. Jr.; Taylor, R.J.; Neikirk, D.P.; Rutledge, D.B. (University of California, Los Angeles, California 90024). *Review of Scientific Instruments;* **56**: No. 5, 903-904(May 1985).

A 20-channel interferometer has been developed which utilizes a linear, one-dimensional microbolometer array to obtain single-shot density profiles from the UCLA Microtor tokamak plasma. The interferometer has been used to study time-dependent phenomena in the plasma density profile. Observations of the sawtooth instability clearly show the growth of the m = 0 mode from a localized oscillation (r = 1 cm) on axis to an oscillation of the entire plasma. Also, measurements during the initial startup phase of the discharge show evidence of hollow density profiles. In addition, a simultaneous measurement of the poloidal magnetic field has been developed which provides 20 channels of polarimetry. Interferometry and polarimetry both use the same imaging system and the spatial resolution of both measurements has been tested using plastic and crystal-quartz test objects. The signal-to-noise ratio for the polarimeter has also proved adequate for the expected Faraday rotation angle (α/sub max/ = 7^0, I/sub p/ = 70 kA, n = 5 x 10^{13} cm^{-3}).

32946 **CO_2 laser interferometer array for Big Dee.** Fairbanks, E.S. (GA Technologies Incorporated, P. O. Box 85608, San Diego, California 92138). *Review of Scientific Instruments;* **56**: No. 5, 905-907(May 1985).

A 12 channel interferometer array is planned for obtaining electron density profiles on Big Dee. Each channel consists of coaxial CO_2 and HeNe laser beams. The reference beam is formed by splitting off half of the laser power at each wavelength by using acousto-optic modulators which introduce a 40-MHz frequency shift in the reference beam. The detected interference signals from room-temperature visible and IR detectors are mixed with the 40-MHz drive for the acousto-optic cells. The quadrature mixer signals result in phase information due to vibration and phase-velocity variation in the plasma. Simultaneous solution of the two equations describing the phase shift at the two wavelengths yields the phase shift due only to the plasma effects. The arithmetic operations will be performed digitally in real time by a dedicated microprocessor in each channel. The execution speed of the microprocessor is expected to be sufficient for measuring line integral density in the presence of vibrations of 1-mm amplitude at 1 Hz or 10-μm amplitude at 100 Hz. Phase resolution for each channel is $2\pi/64$ and time between samples is 25 μs. Density profiles are derived from chordal line integral density data by computer tomography.

32947 **High-frequency gyrotron scattering diagnostic for instability studies on TARA.** Woskoboinikow, P.; Cohn, D.R.; Gerver, M.; Mulligan, W.J.; Post, R.S.; Temkin, R.J.; Trulsen, J. (MIT Plasma Fusion Center, Cambridge, Massachusetts 02139). *Review of Scientific Instruments;* **56**: No. 5, 914-916(May 1985).

A 1- to 10-kW,>30-ms pulsed, narrow linewidth (<1 MHz), 137-GHz gyrotron is being fabricated for collective Thomson scattering plasma diagnostics on the TARA tandem mirror experiment. The drift cyclotron loss cone, the axial loss cone, harmonics of these instabilities, and the ion two stream instability in the TARA plugs will be studied with this diagnostic.

32948 **Far-infrared laser diagnostic on ELMO Bumpy Torus and extreme far-forward laser scattering on the Impurity Study Experiment.** Casson, W.H.; Hutchinson, D.P.; Ma, C.H.; Staats, P.A.; Wilgen, J.B. (University of Tennessee, Knoxville, Tennessee 37916). *Review of Scientific Instruments;* **56**: No. 5, 917-918(May 1985).

A far-infrared (FIR) laser scattering diagnostic has been installed on the ELMO Bumpy Torus (EBT) experiment, and tests conducted on the system using a TPX Bragg cell show that the system is fully functional. Scattering experiments to date have shown only small detectable signal levels during normal operation and during ion cyclotron heating (ICH) fast-wave and slow-wave propagation experiments. On the Impurity Study Experiment (ISX), the output signal from the rf amplifiers of the FIR interferometer has been spectrum analyzed and shows frequency-shifted sidebands that correspond to extreme far-forward scattering of the laser beam as it passes through the plasma. Although the scattered signal cannot be resolved spatially, the scattered intensity provides information about density fluctuation levels and MHD activity during different modes of operation. Agreement has been found with measurements made by the x-ray diagnostic and the heavy-ion beam probe.

32949 **Fast scanning heterodyne receiver for the measurement of the time evolution of the electron temperature profile on the Tokamak Fusion Test Reactor.** Taylor, G.; Efthimion, P.C.; McCarthy, M.; Fredd, E.; Goldman, M.A.; Kaufman, D. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08544). *Review of Scientific Instruments;* **56**: No. 5, 928-930(May 1985).

Two fast scanning heterodyne receivers, swept between 75—110 and 110—170 GHz in 2 ms every 4 ms, were developed to measure the electron cyclotron emission on the horizontal midplane of the Tokamak Fusion Test Reactor (TFTR) plasma. An absolute, in situ calibration technique enables the determination of the profile of the plasma electron temperature from the fundamental ordinary mode and second harmonic extraordinary mode cyclotron emission intensity, with an accuracy of better than 10%. Temperature measurements made with the scanning receivers agree well with data from laser TV Thomson scattering and x-ray pulse-height analysis measurements. The time evolution of the temperature profile during temperature sawteeth fluctuations is well documented when the period of the fluctuation (30—100 ms) is much longer than the instrument sweep repetition time.

32950 **Absolute calibration of a ten-channel grating polychromator for electron temperature measurements on Princeton large torus.** Cavallo, A.; Cutler, R. (Princeton University, Princeton Plasma Physics Laboratory, Princeton, New Jersey 08544). *Review of Scientific Instruments;* **56**: No. 5, 931-933(May 1985).

It has been possible to calibrate absolutely the ten-channel grating polychromator installed on PLT (Princeton large torus). Radiation from a blackbody source (eccosorb at liquid-nitrogen temperature) was chopped at 275 Hz and the signal detected using a lock-in amplifier with an integration time constant set at 125 s. A cascade of six grating filters was used to eliminate higher-order radiation from the input to the instrument. Each channel could be calibrated in approximately 2 h; under these conditions the rms calibration signal to noise for a typical channel is about 60.

32951 **Perpendicular electron cyclotron emission from hot electrons in TMX-U.** James, R.A.; Ellis, R.F.; Lasnier, C.J.; Casper, T.A.; Celata, C.M. (University of Maryland, College Park, Maryland 20742). *Review of Scientific Instruments;* **56**: No. 5, 934-936(May 1985).

Perpendicular electron cyclotron emission (PECE) from the electron cyclotron resonant heating of hot electrons in TMX-U is measured at 30—40 and 50—75 GHz. This emission is optically thin and is measured at the midplane, f/sub ce/≈14 GHz, in either end cell. In the west end cell, the emission can be measured at different axial positions thus yielding the temporal history of the hot electron axial profile. These profiles are in excellent agreement with the axial diamagnetic signals. In addition, the PECE signal level correlates well with the diamagnetic signal over a wide range of hot electron densities. Preliminary results from theoretical modeling and comparisons with other diagnostics are also presented.

32952 **Magnetic diagnostics and feedback control on TFTR (invited).** Coonrod, J.; Bell, M.G.; Hawryluk, R.J.; Mueller, D.; Tait, G.D. (Princeton University, Princeton, New Jersey 08544). *Review of Scientific Instruments;* **56**: No. 5, 941-946(May 1985).

The various operating modes of TFTR require the use of a sophisticated system of magnetic diagnostics integrated with a feedback control system. This system has successfully controlled the plasma current and position over a range of major and minor radii, during strong compression, and will soon be used during intense neutral beam heating. Current and position values are held constant to within 2 kA and 1 cm. A wide variety of preoperational field measurements were required to determine proper compensation for dynamic stray fields due to eddy currents. Data from plasma profile diagnostics, such as bolometer arrays, Thomson scattering, soft x-ray diode array, and the scanning radiometer, have been compared to the absolute position deduced from magnetics. In addition to control functions, magnetic diagnostics on TFTR provide data on plasma current asymmetry, β/sub theta/, MHD fluctuations, loop voltage, and flux consumption. This paper will discuss the mechanical and electronic design constraints, as well as the analytic and calibration techniques required.

32953 Plasma potential formation and measurement in TMX-U and MFTF-B (invited). Grubb, D.P. (Lawrence Livermore National Laboratory, University of California, Livermore, California 94550). *Review of Scientific Instruments;* **56**: No. 5, 947-952(May 1985).

Tandem mirrors control the axial variation of the plasma potential to create electrostatic "plugs" that improve the axial confinement of central cell ions and, in a thermal barrier tandem mirror, control the electron axial heat flow. Measurements of the spatial and temporal variations of the plasma potential are, therefore, important to the understanding of confinement in a tandem mirror. In this paper we discuss potential formation in a thermal barrier tandem mirror and examine the diagnostics and data obtained on the TMX-U device, including measurements of the thermal barrier potential profile using a diagnostic neutral beam and charged-particle energy spectroscopy. We then describe the heavy ion-beam probe and other new plasma potential diagnostics that are under development for TMX-U and MFTF-B.

32954 Application of optical phase conjugation to plasma diagnostics (invited). Jahoda, F.C.; Anderson, B.T.; Forman, P.R.; Weber, P.G. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Review of Scientific Instruments;* **56**: No. 5, 953-957(May 1985).

Several possibilities for plasma diagnostics provided by optical phase conjugation and, in particular, self-pumped phase conjugation in barium titanate ($BaTiO_3$) are discussed. These include placing a plasma within a dye laser cavity equipped with a phase conjugate mirror for intracavity absorption measurements, time differential refractometry with high spatial resolution, and simplified real-time holographic interferometry. The principles of phase conjugation with particular reference to photorefractive media and the special advantages of self-pumped phase conjugation are reviewed prior to the discussion of the applications. Distinctions are made in the applications between those for which photorefractive conjugators are essential and those for which they only offer experimental simplification relative to other types of phase conjugators.

32955 Phaedrus diagnostic system. Breun, R.; Brouchous, D.; Ferron, J.; Golovato, S.; Hershkowitz, N.; Pew, J.; Brooker, P.; Persing, H.; Ross, S.; Sing, D. (Nuclear Engineering Department, University of Wisconsin-Madison, Madison, Wisconsin 53706). *Review of Scientific Instruments;* **56**: No. 5, 958-959(May 1985).

The Phaedrus diagnostic system makes optimum use of probes and miniature gridded energy analyzers to measure detailed parameters such as density, plasma potential, and electron and ion energy. This requires miniaturization and provision for flexible access. Other diagnostics are made as flexible as possible. A multiple-aperture, end-loss analyzer is rotatable, allowing complete mapping of the end wall loss contours. Self-emissive probes are used to measure plasma potential contours in the end plugs. A single-channel neutral energy analyzer is movable and can be swept in energy. Secondary emission detector arrays supplement the neutral energy analyzer and give a measure of the ion energy versus pitch angle. Calibrated diamagnetic loops are used to measure the total plasma energy and its axial extent in each cell. Both permanent and insertable fast ion gauges are available. Completing the diagnostic system is a computerized data-acquisition system that is flexible and receptive to the time varying demands of the many ongoing experiments.

32956 TARA diagnostic set. Sevillano, E.; Brau, K.; Goodrich, P.; Irby, J.; Mauel, M.; Post, R.S.; Smith, D.K.; Sullivan, J. (Plasma Fusion Center, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Review of Scientific Instruments;* **56**: No. 5, 960-962(May 1985).

The TARA Tandem Mirror Experiment has recently begun operation. The set of diagnostics available at this time is discussed. The following diagnostics are now in use: diamagnetic loops, a multichord microwave interferometer, Langmuir and emissive probes, pick-up loops, and secondary-emission detectors. End-loss diagnostics include net current detector arrays, Faraday cup arrays, swept particle analyzer arrays, and calorimetry. Light-emission measurements are made in the visible and VUV regions. A multichord fiber-optic array for plasma position detection is also used. In addition, a three-channel charge exchange analyzer, a hard x-ray system, and fast pressure gauges are available.

32957 TFTR diagnostic control and data acquisition system. Sauthoff, N.R.; Daniels, R.E.; PPL Computer Division. (Princeton University, Plasma Physics Laboratory, Princeton, New Jersey 08544). *Review of Scientific Instruments;* **56**: No. 5, 963-965(May 1985).

General computerized control and data-handling support for TFTR diagnostics is presented within the context of the Central Instrumentation, Control and Data Acquisition (CICADA) System. Procedures, hardware, the interactive man—machine interface, event-driven task scheduling, system-wide arming and data acquisition, and a hierarchical data base of raw data and results are described. Similarities in data structures involved in control, monitoring, and data acquisition afford a simplification of the system functions, based on "groups" of devices. Emphases and optimizations appropriate for fusion diagnostic system designs are provided. An off-line data reduction computer system is under development.

32958 Fusion gamma diagnostics. Medley, S.S.; Cecil, F.E.; Cole, D.; Conway, M.A.; Wilkinson F.J. III. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08544). *Review of Scientific Instruments;* **56**: No. 5, 975-977(May 1985).

Nuclear reactions of interest in fusion research often possess a branch yielding prompt emission of gamma radiation in excess of 15 MeV which can be exploited to provide a new fusion reaction diagnostic having applications similar to conventional neutron emission measurements. Conceptual aspects of fusion gamma diagnostics are discussed with emphasis on application to the Tokamak Fusion Test Reactor (TFTR) during deuterium neutral beam heating of D—T and D—^{3}He plasmas. Recent measurements of the D (T, $\gamma)^5$He, D(^{3}He, $\gamma)^5$Li, and D(D, $\gamma)^4$He branching ratios at low center-of-mass energy (30—100 keV) and of the response of a large volume Ne226 detector for gamma detection in high neutron backgrounds are presented. Using a well-shielded Ne226 detector during 20 MW—120 kV deuterium beam heating of a tritium plasma in TFTR, the D(T, $\gamma)^5$He gamma signal level is estimated to be 3.5×10^5 cps.

32959 Tandem-Mirror Experiment-Upgrade neutral pressure measurement diagnostic systems. Pickles, W.L.; Allen, S.L.; Hill, D.N.; Hunt, A.L.; Simonen, T.C. (Lawrence Livermore National Laboratory, University of California, Livermore, California 94550). *Review of Scientific Instruments;* **56**: No. 5, 978-980(May 1985).

The Tandem-Mirror Experiment-Upgrade (TMX-U) has a large and complex system of Bayard—Alpert, magnetron, and Penning gauges, in addition to mass spectrometers (RGA), all of which measure neutral pressures in the many internal regions of TMX-U. These pressure measurements are used as part of the confinement physics data base as well as for management of the TMX-U vacuum system. Dynamic pressures are modeled by a coupled-volumes simulation code, which includes wall reflux, getter pumping, and plasma pumping.

32960 Determination of experimental tokamak plasma profiles using maximum-entropy analysis. Cottrell, G.A.; Fairbanks, E.S.; Stockdale, R.E. (GA Technologies Incorporated, P. O. Box 85608, San Diego, California 92138). *Review of Scientific Instruments;* **56**: No. 5, 984-986(May 1985).

The diagnostician commonly faces the problem of extracting the maximum information on plasma spatial profiles from only a very limited and noisy data set. Conventionally, functional forms (e.g., a parabola raised to a power) are fitted to the measured data using nonlinear least-squares regression. This immediately biases the interpretation and constrains results to a narrow family of curves for which there may be no real evidence in the data. In this paper, we examine the consequences of abandoning this assumption and, instead, seek the constrained maximum entropy (ME) profile making no such assumptions. Results are compared with conventional analysis. The ME method has the inherent advantages of (i) yielding only positive (and therefore physically meaningful) profiles, (ii) suppression of noise on the data, and (iii) producing a profile which contains the least amount of spurious detail. The method is illustrated with reference to measured chord-average CO_2 laser interferometer data taken on the Doublet III tokamak.

32961 Neutron streak camera electron gun design. Close, E.R.; Colonias, J.S. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Review of Scientific Instruments;* **56**: No. 5, 990-992(May 1985).

Representative values for electrode voltages, time compensation, and transmission efficiency are obtained by computer simulation for a preliminary design of an electron gun to be used in a neutron streak camera application. The calculations indicate a time resolution on the order of 20 ps and a transmission efficiency of about 10%.

32962 Impurity monitoring by laser-induced fluorescence techniques (invited). Gelbwachs, J.A. (Chemistry and Physics Laboratory, The Aerospace Corporation, P.O. Box 92957, Los Angeles, California 90009). *Review of Scientific Instruments;* **56**: No. 5, 1000-1005(May 1985).

Laser-induced fluorescence spectroscopy can provide a highly sensitive and selective means of atomic and ionic impurity detection. Because the photodetector can be physically isolated from the laser-excited region, these techniques can be applied to monitoring in hostile environments. The basic concepts behind fluorescence detection are reviewed. Saturated optical excitation is shown to maximize impurity atom emission yield while mitigating effects of laser intensity fluctuations upon absolute density calibration. A comparison of monitoring in high- and low-pressure monitoring environments is given. Methods to improve detection sensitivity by luminescence background suppression are presented.

32963 TFTR Thomson scattering system. Johnson, D.; Dimock, D.; Grek, B.; Long, D.; McNeill, D.; Palladino, R.; Robinson, J.; Tolnas, E. (Princeton Plasma Physics Laboratory, Princeton, New Jersey 08544). *Review of Scientific Instruments;* **56**: No. 5, 1015-1017(May 1985).

The TFTR Thomson scattering system has been operational since January 1984. The diagnostic uses two ruby lasers and two spectrometer-detector systems to provide profiles at two times in a discharge. The two scattering lines consist of 76 spatial channels which span the 200-cm vacuum vessel along a major radius. The detectors are gated, intensified CCD arrays with single photoelectron sensitivity. T/sub e/(R) and N/sub e/(R) profiles are presented.

32964 Evolution of low-density Thomson scattering on ELMO Bumpy Torus. Cobble, J.A. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Review of Scientific Instruments;* **56**: No. 5, 1018-1020(May 1985).

The ELMO Bumpy Torus (EBT) confines a low-density, steady-state, microwave-driven plasma. On the basis of favorable initial diagnostic results, major machine upgrades: increases in microwave power and magnetic field: were initiated, and the feasibility of Thomson scattering was considered. From the time of the first laser measurements, in which a two-point spectrum was integrated during 30 or more Q-switched pulses, the Thomson scattering system has evolved into a reliable diagnostic tool that is able to obtain scans along 20 cm of the plasma diameter and to determine the central electron temperature at densities as low as 2 x 10^{11} cm^{-3}. Based on a 25-J ruby laser and a seven-channel polychrometer, the present system (1) reveals a bulk plasma with T/sub e/ = 20—100 eV and n/sub e/ = 5—10 x 10^{11} cm^{-3} and (2) indicates a suprathermal tail consistent with x-ray measurements. With up to 200 kW of microwave power inside the machine, major problems to overcome were radiation damage to optical materials (< or =3000 R/h) and plasma coating of windows and dumps.

32965 Development and application of multichannel collective scattering systems. Park, H.; Brower, D.L.; Peebles, W.A.; Luhmann N.C. Jr.; Savage R.L. Jr.; Yu, C.X. (University of California, Los Angeles, California 90024). *Review of Scientific Instruments;* **56**: No. 5, 1055-1056(May 1985).

The numerous applications of cw collective Thomson scattering in fusion plasmas are greatly enhanced by the addition of a multichannel capability. This permits the determination of the dispersive properties (ω vs k) of waves on a single tokamak discharge. This paper describes the development, calibration, and application of such systems in the far-infrared spectral region. The measurement of the wave dispersion of externally excited ion Bernstein waves leads to the determination of ion temperature in a tokamak plasma. In addition, the study of naturally occurring microturbulence has produced a series of unique observations which has both motivated theoretical effort and clarified the role of density fluctuations in anomalous transport.

32966 Detector development for γ-ray diagnostics of D-T fusion reactions. Moran. (Lawrence Livermore National Laboratory, University of California, P.O. Box 808, Livermore, California 94550). *Review of Scientific Instruments;* **56**: No. 5, 1066-1068(May 1985).

The development of D-T fusion-energy sources requires intimate and precise measurement of fusion-burn conditions in reactor-development experiments. Some of the limitations inherent in presently available diagnostics based on massive particle emissions can be overcome by measuring fusion-generated high-energy γ rays. Although γ-ray intensities are low, γ rays offer diagnostic advantages of dispersion-free propagation and low intrinsic backgrounds. This paper describes two detector systems developed to study D-T fusion reactions by measuring the associated 16.7-MeV γ-ray emissions. The first system is a Compton-recoil spectrometer and features good energy resolution of the 16.7-MeV photons. This system uses a sector-magnet spectrometer to isolate electrons forward scattered by the high energy γ rays. The second system is a threshold Cerenkov detector and features a higher net sensitivity. A chamber filled with Co_2 gas acts as a Cerenkov medium for electrons scattered by the 16.7-MeV photons. The gas pressure is adjusted so that electrons scattered by photons having energies less than 16.7 MeV do not have sufficient energy to generate Cerenkov light in the gas.

32967 Alpha particle diagnostic based on damping of lower hybrid waves. Wong, K. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08544). *Review of Scientific Instruments;* **56**: No. 5, 1073-1074(May 1985).

The feasibility of using lower-hybrid wave damping measurement as a diagnostic for energetic (above 200 keV) alpha particles has been investigated for large tokamaks like TFTR and FED devices. Detailed ray tracing calculations show that slow lower-hybrid waves can be used for TFTR, but the fast lower-hybrid wave is necessary for wave penetration into the dense plasma core of FED. It is possible to launch waves mainly damped on the energetic alpha particles whose velocity distribution function f/sub proportional/(r,v,t) is related to the wave damping rate. A 1% energetic alpha-particle concentration would cause substantial wave damping measurable by FIR laser scattering systems. Preliminary estimates show that this technique should yield good temporal resolution ($\sim$1 ms) and some spatial resolution for the alpha-particle distribution function. However, extensive computation is necessary to unfold the velocity dependence if it is at all possible.

32968 **New method for measuring ion temperatures in hot D—T plasma.** Smither, R.K.; Greenwood, L.R.; Hendel, H. (Argonne National Laboratory, Argonne, Illinois 60439). *Review of Scientific Instruments;* **56**: No. 5, 1078-1080(May 1985).

A new method has been found to measure the ion temperature of a hot D—T plasma. The new method makes use of two new neutron dosimetry reactions, ^{54}Fe(n,2n)^{53}Fe and ^{27}Al(n,2n)^{26}Al. What makes these reactions special is that their threshold energies are quite close to the centroid of the energy distribution of the neutrons emitted from a D—T plasma. This makes their reaction yields sensitive to only the upper half of the neutron energy distribution and therefore sensitive to both changes in the centroid and the width of the neutron energy distribution. The sensitivity to the width of the neutron energy distribution allows one to measure the ion temperature. If the plasma is in thermal equilibrium the ion temperature can be calculated from the ratio of the yields of the ^{54}Fe(n,2n)^{53}Fe reaction to the ^{27}Al(n, p)^{27}Mg reaction or a similar nonsensitive reaction. No absolute measurements are needed. Using both of the new dosimetry reactions the asymmetry of the neutron energy distribution for nonequilibrium conditions (neutral beams) can be measured. The ^{54}Fe(n,2n)^{53}Fe reaction is sensitive enough to monitor a single shot in TFTR.

32969 **Collimated ZnS (Ag)-detector array for Tokamak Fusion Test Reactor neutron source strength radial profile measurements.** Hendel, H.W.; Ku, L.P.; Long, D.C.; Nieschmidt, E.B.; Strachan, J.D. (Princeton University, Plasma Physics Laboratory, Princeton, New Jersey 08544). *Review of Scientific Instruments;* **56**: No. 5, 1081-1083(May 1985).

Time-resolved radial profile measurements of neutron source strength and T/sub i/ are required to determine ion energy balance especially during sawtooth oscillations and adiabatic compression. We describe the Tokamak Fusion Test Reactor (TFTR) vertical multichannel (10) collimator, two channels of which are now being completed. ZnS detectors will be used (Bicron 720) to reject γ rays and scattered neutrons, and operated in both count rate and current modes. The frequency response is limited by counting statistics and sampling times, but resolves compression times $\approx$15—30 ms and T/sub i/ collapse times during sawtooth $\approx$2—3 ms. The collimator consists of the 6-ft test cell floor plus ~2-ft detector shield. Detector cross talk is calculated to be negligible. The dynamic range of the detectors is $>$ or $\approx 10^6$, covering the range from ohmically heated deuterium (2.5 MeV neutron emissions of $>$ or $\approx 10^{13}$ s^{-1}) to deuterium-beam heated tritium plasmas (14 MeV, $<$ or $\approx 10^{19}$ s^{-1}).

32970 **Effects of neutron energy spectrum on the efficiency calibration of epithermal neutron detectors.** Nieschmidt, E.B.; England, A.C.; Hendel, H.W.; Hillis, D.L.; Isaacson, J.A.; Ku, L.P.; Tsang, F.Y. (Princeton University, Plasma Physics Laboratory, Princeton, New Jersey 08544). *Review of Scientific Instruments;* **56**: No. 5, 1084-1086(May 1985).

The ^{235}U epithermal neutron fission detector system at TFTR has been calibrated in situ, using three different neutron sources: ^{252}Cf, a D-D, and a D-T neutron generator. These sources produced a continuous spectrum, a line spectrum at ~2.5 MeV, and a line spectrum at ~14 MeV, respectively. The toroidally averaged detection efficiencies are 4.61 x 10^{-9} (^{252}Cf), 4.80 x 10^{-9} (D-D), and 5.42 x 10^{-9} (D-T) counts/neutron for a moderated 1.3-g ^{235}U detector placed ~4 m from the torus centerline. The effects of (n,2n) and (n,n′γ) reactions are discussed.

32971 **^{3}He gas scintillation spectrometer for fusion neutron measurements.** Derzon, M.S.; Slaughter, D.R.; Prussin, S.G. (Nuclear Engineering Department, University of California, Berkeley, California 94720). *Review of Scientific Instruments;* 56: No. 5, 1090-1092(May 1985).

A high-efficiency, good resolution neutron spectrometer can obtain time-resolved fusion rates and mean ion energies from yield and Doppler width measurements of the 2.5 -MeV neutron peak. Gas scintillation spectrometers are capable of operating at high data rates. In order to obtain adequate energy resolution large light yields and uniform light collection over the active detector volume are required. We have measured the absolute light yield from He—Xe gas mixtures. With a high light collection efficiency the detected photon yield from the ^{3}He(n, p)t reaction due to D—D neutrons will give adequate statistics for resolutions of a few percent. Calculations have been performed to model the detector optics in an effort to optimize the light yield and the uniformity of response. Measurements of detector resolution and time response have been made.

32972 **Approaches to ultrafast neutron detectors.** Wang, C.L.; Kalibjian, R.; Singh, M.S.; Wiedwald, J.D.; Campbell, D.E.; Campbell, E.M.; Cable, M.D.; Graves, W.R.; Lane, S.M.; Lerche, R.A.; Price, R.H.; Stearns, D.G.; Mourou, G.A.; Prussin, S.G. (Lawrence Livermore National Laboratory, University of California, Livermore, California 94550). *Review of Scientific Instruments;* **56**: No. 5, 1096-1097(May 1985).

We discuss two approaches to obtain neutron detectors of very high temporal resolution. In the first approach, a uranium-coated cathode is used in a streak tube configuration. Secondary electrons accompanying the fission fragments from a neutron-uranium reaction are accelerated, focused through a pinhole, and streaked. Calculations show that 20-ps time resolution can be obtained. In the second approach, a uranium-coated cathode is integrated into a transmission line. State-of-the-art technology indicates that a time resolution of 20 ps can be obtained by gating the cathode with a fast electric pulse.

32973 **Nuclear techniques for determining the spatial and energy distribution of fast-confined alpha particles in ignited D—T plasma.** Slaughter, D.R. (University of California, Lawrence Livermore National Laboratory, Livermore, California 94550). *Review of Scientific Instruments;* **56**: No. 5, 1100-1102(May 1985).

There are several nuclear reactions between fast-confined α particles and low-z ions in ignited D—T plasma. Some of them produce unique and highly penetrating neutron or γ radiation. A study has begun to evaluate the feasibility of using these reactions to determine the spatial profile of fast-confined reaction product α particles, and to determine a crude envelope of their speed distribution as they thermalize. Particular attention is paid to the means of detecting these radiations, measuring their spectra, and most important of all, reducing and discriminating against the very much larger background of interfering radiation.

32974 **Neutral beam species measurements using in situ Rutherford backscatter spectrometry.** Kugel, H.W.; Kaita, R.; Gammel, G.; Williams, M.D. (Plasma Physics Laboratory, Princeton University, P. O. Box 451, Princeton, New Jersey 08544). *Review of Scientific Instruments;* **56**: No. 5, 1105-1107(May 1985).

This work describes a new in situ method for measuring the neutral particle fractions in high-power deuterium neutral beams, used to heat magnetically confined fusion plasmas. Deuterium beams, of variable energies, pulse lengths, and powers up to 47 keV, 100 ms, 1.6 MW, were Rutherford backscattered at 135° from the TiC inner neutral beam armor of the PDX, and detected using an electrostatic analyzer with a microchannel plate. Complete energy scans were made every 20 ms and data were obtained simultaneously from five different positions across the beam profile. The neutral particle fractions were measured to be $D^0(E):D^0(E/2):D^0(E/3) = 53:32:15$. The corresponding neutral power fractions were $P^0(E):P^0(E/2):P^0(E/3) = 72:21:7$, and the associated ionic fractions at the output of the ion source were $D^+{}_1\,(E):D^+{}_2\,(E):D^+{}_3\,(E) = 74:20:6$. The measured neutral particle fractions were relatively constant over more than 70% of the beam power distribution. A decrease in the yield of the full-energy component in the outer regions of the beam was observed.

32975 **Improved performance for large area triple layer microchannel-plate detector for a neutral particle spectrometer in Doublet III.** Armentrout, C.J. (GA Technologies Inc., P. O. Box 85608, San Diego, California 92138). *Review of Scientific Instruments;* **56**: No. 5, 1108-1110(May 1985).

A 2 x 30-cm three-layer, microchannel-plate (MCP) assembly has been constructed with 120 anodes to collect electrons. It has a gain of up to 5 x 10^8 in the pulse counting mode. The device displays an unexpectedly high per-anode count rate. The original device had major problems: 5 x gain variation along its length and 150% FWHM/gain ratio. It is shown through a model distribution function that both effects can be due to the space charge limiting of pulses that cross the interstage gaps. One detector was rebuilt with greatly reduced interstage gaps and now displays 60% FWHM/gain and a 30% gain variation. This has significantly improved the pulse counting capability of the spectrometer.

32976 EparallelB end-loss-ion analyzer for Tandem-Mirror Experiment-Upgrade. Foote, J.H.; Coutts, G.W.; Pedrotti, L.R.; Schlander, L.; Wood, B.E. (Lawrence Livermore National Laboratory, University of California, Livermore, California 94550). *Review of Scientific Instruments;* **56**: No. 5, 1117-1119(May 1985).

We are constructing and testing a diagnostic instrument to investigate, in detail, ions emanating along magnetic field lines from the plasma region of the TMX-U tandem-mirror experiment. This analyzer (of Tokamak Fusion Test Reactor design) contains parallel electric and magnetic fields, which yield ion mass and energy spatial separation, respectively. A two-dimensional array of 128 copper collector plates detects the particles. The entering ion flux is first well collimated and then focused onto the detector plane during the 180° bending in the magnetic field. This instrument is designed to measure higher particle energies than the present gridded end-loss analyzers as well as determine the energy spectra more accurately. Tandem-mirror plasma parameters to be investigated with this analyzer include end-plug potential, average central-cell-ion energy, and plasma potential in the thermal barrier and nearby regions. We plan a time resolution of up to 2 kHz for each detector.

32977 Lanthanum hexaboride tapered filament in a plasma source. Pincosy, P.A.; Leung, K.N. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Review of Scientific Instruments;* **56**: No. 5, 655-658(May 1985). Contract AC03-76SF00098.

A directly heated lanthanum hexaboride tapered filament has been tested in a plasma generator. A uniform temperature distribution at 1820 K has been achieved. The heating and cooling power calculated from measured quantities are balanced. A maximum arc current of 80 A was obtained, limited only by the power supply and plasma generator. The corresponding hydrogen ion current density was 0.6 A/cm^2 when the arc voltage was 80 V and the filament heater current was about 5 A. The filament was capable of emitting 100 A of current at an operating temperature of 1900 K. The estimated lifetime for this filament is 900 h.

32978 Statistical theory of cubic langmuir turbulence. Sun, G.; Nicholson, D.R.; Rose, H.A. (Department of Physics and Astronomy, The University of Iowa, Iowa City, Iowa 52240). *Physical Review Letters;* **54**: No. 15, 1664-1667(15 Apr 1985). Contract AC02-82ER53136.

The cubic direct-interaction approximation is applied to the truncated cubically nonlinear Schroedinger equation. The statistical theory does a satisfactory job in several important respects.

32979 Spectrum of resistive MHD modes in cylindrical plasmas. Ryu, C.M.; Grimm, R.C. (Princeton Univ., NJ (USA). Plasma Physics Lab.). *Journal of Plasma Physics;* 32: 207-237(Oct 1984).

A numerical study of the normal modes of a compressible resistive MHD fluid in cylindrical geometry is presented. Resistivity resolves the shear Alfven and slow magnetosonic continua of ideal MHD into discrete spectra and gives rise to heavily damped modes whose frequencies lie on specific lines in the complex plane. Fast magnetosonic waves are less affected but are also damped. Overstable modes arise from the shear Alfven spectrum. The stabilizing effect of favourable average curvature is shown. Eigenfunctions illustrating the nature of typical normal modes are displayed.

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REFER ALSO TO CITATION(S) 30058, 31466, 31767, 31944, 31977, 32959

32980 (AD-A—150519/7/XAB) Increased hot-electron production at quarter-critical density in long-scalelength, laser-plasma interactions. Memorandum report, September-October 1984. Young, F.C.; Herbst, M.J.; Manka, C.K.; Obenschain, S.P.; Gardner, J.H. (Naval Research Lab., Washington, DC (USA)). 11 Feb 1985. 14p. (NRL-MR—5484). NTIS, PC A02/MF A01.

Hot-electron fractions measured in Nd-laser-plasma interactions at 1014W/cm2 increase from <0.02% to 0.3% as the plasma scalelength at quarter-critical density (nc/4)is systematically increased from 140 microns to 320 microns. Correlated x-ray and 3w/2 emissions indicate that the hot electrons are produced by a nc/4 instability.

32981 (AERE-R—11321) Report on a visit to Canada to discuss tritium instrumentation and radiological protection. Gibson, J.A.B. (UKAEA Atomic Energy Research Establishment, Harwell. Environmental and Medical Sciences Div.). Oct 1984. 27p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85701235.

A report is presented of a visit to Canada on behalf of the CEC DG II/Fusion between the 8th to 13th April 1984. Discussions were arranged by the Canadian Fusion-Fuels Technology Project near Toronto and covered all aspects of tritium technology but especially radiological protection. Visits included the CFFTP Centre, Pickering Nuclear Generating Section, Ontario Hydro's Head Office, Safety Services Department and Research Division, Scintrex Ltd (tritium instrument manufacturers) and the Atomic Energy of Canada (AECL) Chalk River Nuclear laboratories (CRNL). There are clearly many areas for the use of Canadian Technology in Europe, particularly with CRNL and Scintrex on the development of $^3H_2/^3H_2O$ discriminating monitors. There is some doubt whether these development will be in time for applications at the JET laboratory and the JRC at ISPRA but this collaboration will be pursued.

32982 (CONF-831203—193) Maintenance and availability considerations for MFTF-B upgrade. Spampinato, P.T. (Oak Ridge National Lab., TN (USA)). 1983. Contract AC05-84OR21400. 6p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85012344.

From 10. symposium on fusion engineering; Philadelphia, PA, USA (5 Dec 1983).

The upgrade of the Mirror Fusion Test Facility (MFTF-B) tandem mirror device incorporates the operation of advanced systems plus the requirement for remote maintenance. To determine if the operating availability goal of this device is achievable, an assessment of component lifetimes was made, along with estimates of device downtime. Key subsystem components were considered from the magnet, heating, impurity control, pumping, and test module systems. Component replacements were grouped into three categories, and a lifetime operating plan, including component replacements, was developed. It was determined that this device could achieve a 10% operating availability.

32983 (CONF-840311—18) Status of gyrotron developments at Varian Associates. Jory, H. (Varian Associates, Inc., Palo Alto, CA (USA)). 1984. Contract AC05-84OR21400. 7p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85011576.

From 4. international symposium on heating in toroidal plasmas; Rome, Italy (21 Mar 1984).

The status of gyrotrons developed by Varian for fusion heating applications will be briefly reviewed. Development work started in 1976 with the goal of 200 kW CW at 28 GHz. A more recent program was to develop 200 kW CW at 60 GHz. Pulsed and CW tubes produced by these programs will be briefly described and the scaling of these designs to other frequencies including 53, 56 and 70 GHz will be discussed. A 35 GHz design will also be described. Future efforts for gyrotrons at 120 and 140 GHz will also be discussed.

32984 **(CONF-850301—7) Stellarator approach to fusion plasma confinement.** Harris, J.H. (Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 13p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85011420.

From 12. annual energy technology conference and exposition; Washington, DC, USA (25 Mar 1985).

The stellarator is a toroidal fusion plasma confinement device with nested magnetic flux surfaces. The required twist of the field lines is produced by external helical coils rather than by plasma current, as in a tokamak. Stellarator devices are attractive fusion reactor candidates precisely because they offer the prospect of steady-state operation without plasma current. In the last few years the excellent results achieved with currentless stellarator plasmas of modest minor radius (10 to 20 cm) at Kyoto University (Japan) and the Max Planck Institute (West Germany) have made the stellarator second only to the tokamak in its progress toward fusion breakeven, with temperatures T/sub e/, T/sub i/ ~ 1 KeV, Lawson products n tau ~ 2 to 5 x 10^{12} cm^{-3}.s, and volume-averaged beta values $\approx$ 2%. The Advanced Toroidal Facility (ATF), now under construction at Oak Ridge Natioal Laboratory (ORNL) and scheduled to operate in 1986, represents a significant advance in stellarator research, with a plasma major radius of 2.1 m, an average minor radius of 0.3 m, and a magnetic field of 2 T for 5 s or 1 T at steady state. ATF replaces the Impurity Study Experiment (ISX-B) tokamak at ORNL and will use the ISX-B heating and diagnostic system.

32985 **(CONF-850310—96) Economic analysis of fusion breeders.** Delene, J.G. (Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85011560.

From 6. topical meeting on the technology of fusion energy; San Francisco, CA, USA (3 Mar 1985).

This paper presents a study of the economic performance of Fission/Fusion Hybrid devices. This work takes fusion breeder cost estimates and applies methodology and cost factors used in the fission reactor programs to compare fusion breeders with Liquid Metal Fast Breeder Reactors (LMFBR). The results of the analysis indicate that the Hybrid will be in the same competitive range as proposed LMFBRs and have the potential to provide economically competitive power in a future of rising uranium prices. The sensitivity of the results to variations in key parameters is included.

32986 **(CONF-850310—97) Assessment of magnetic field asymmetries in ELMO Bumpy Square.** Uckan, T.; Uckan, N.A. (Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85011559.

From 6. topical meeting on the technology of fusion energy; San Francisco, CA, USA (3 Mar 1985).

There exist two separate and independent magnetic field asymmetries in the ELMO Bumpy Square (EBS). One is associated with the small perturbations in the magnetic field, known as the field errors, caused by coil misalignments during installation, imperfection in coil winding, etc. The second source of asymmetry is the magnetic field ripple in the high-field toroidal solenoids (corners) produced by the finiteness of the number of coils. In general, these two sources of asymmetry introduce enhanced transport losses (in addition to other effects, to the system, although they affect different classes of particles. Toroidally passing (circulating) particles (v/sub parallel//v ~ 1) are influenced by the field errors, whereas trapped particles (v/sub parallel//v ~ 0) in the corners are influenced by the field ripple. In this paper we discuss these two effects separately and calculate the allowable magnitudes of the field error and field ripple in EBS, both for an experimental-size device and for a reactor.

32987 **(CONF-850310—99) Advanced Toroidal Facility (ATF).** Thompson, P.B. (Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85011567.

From 6. topical meeting on the technology of fusion energy; San Francisco, CA, USA (3 Mar 1985).

The Advanced Toroidal Facility (ATF) is a new magnetic plasma confinement device, under construction at Oak Ridge National Laboratory (ORNL), which will lead to improvements in toroidal magnetic fusion reactors. ATF is a type of stellarator known as a torsatron which theoretically has the capability at ≧8% beta in steady state. The ATF plasma has a major radius of 2.1 m, an average minor radius of 0.3 m, and a field of 2 T for a 5-s duration or 1 T steady state. The ATF device consists of a helical field (HF) coil set, a set of poloidal field (PF) coils, an exterior shell structure to support the coils, and a thin helically contoured vacuum vessel inside the coils. The ATF replaces the ISX-B tokamak at ORNL and will use the ISX-B auxiliary systems including 4 MW of neutral injection heating and 0.2 MW of electron cyclotron heating. ATF device is scheduled to start operation in the fall of 1986. An overview of the ATF device is presented including details of the construction process envisioned.

32988 **(CONF-850310—102) Technical benefit of an international project.** Flanagan, C.A. (Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 5p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85012781.

From 6. topical meeting on the technology of fusion energy; San Francisco, CA, USA (3 Mar 1985).

One critical issue examined in the present phase of the International Tokamak Reactor (INTOR) has been an evaluation of the technical benefit of dividing up the design and component production tasks of all major advanced technologies among all participants. Two approaches were evaluated: (1) a "splitting" approach in which each country provides 1/4 of the components of each major system (e.g., 3 of 12 TF coils), (2) a "branching" approach in which each country provides all components of selected major systems (e.g., first country provides all TF coils, second country provides all torus sectors, etc.). Quantitative cost and schedule estimates were developed for each of the two approaches and compared to the cost and schedule of the entire device if it were produced only by one country. The results of the US evaluation indicated that the ratio of total estimated cost to the "national" cost was 1.66 for "splitting" and 1.20 for "branching". The cost per participant was 0.41 and 0.30, respectively. The increase in the construction schedule was estimated to be 2.6 years.

32989 **(CONF-850310—105) Fusion facility siting considerations.** Bussell, G.T. (Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 6p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85012894.

From 6. topical meeting on the technology of fusion energy; San Francisco, CA, USA (3 Mar 1985).

Inherent in the fusion program's transition from hydrogen devices to commercial power machines is a general increase in the size and scope of succeeding projects. This growth will lead to increased emphasis on safety, environmental impact, and the external effects of fusion in general, and of each new device in particular. A critically important consideration in this regard is site selection. The purpose of this paper is to examine major siting issues that may affect the economics, safety, and environmental impact of fusion.

32990 **(DOE/DP/40200—T1) Thermal transport measurements of uv laser irradiated spherical targets.** Jaanimagi, P.A.; Delettrez, J.; Henke, B.L.; Richardson, M.C. (Rochester Univ., NY (USA). Lab. for Laser Energetics). [1985]. Contract FC08-85DP40200;AS08-82DP40175. 36p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85011038.

New measurements are presented of thermal transport in spherical geometry using time-resolved x-ray spectroscopy. We determine the time dependence of the mass ablation rate m(dot) by following the progress of the ablation surface through thin layers of material embedded at various depths below the surface of the target. These measurements made with 6 and 12 uv (351 nm) beams from OMEGA are compared to previous thermal transport data and are in qualitative agreement with detailed LILAC hydrodynamic code simulations which predict a sharp decrease in m(dot) after the peak of the laser pulse. Non-uniform laser irradiation of the target results in the anomalously high values of m(dot) measured in these experiments.

32991 (DOE/ER/40112—T1) Theoretical and computational research on the focused transport of intense charged particle beams. Annual report, August 1983-September 1984. Haber, I. (Naval Research Lab., Washington, DC (USA)). 1984. Contract AI05-83ER40112. 16p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85012980.

Computer calculations were used to investigate the behavior of a periodic solenoidal thin-lens focusing system with 90° phase advance. Despite strong similarities in the behavior predicted by the linear theory, a 90° solenoidal system does not appear to exhibit the emittance growth characteristic of the similar 90° alternate gradient system. In other ways, however, behavior is observed which is similar to the analagous alternate gradient system. (MOW)

32992 (DOE/ER/53179—T3) Preparation and use of very pure o-D_2. Technical report No. 1. Honig, A.; Lewis, M.; Yu, Z.Z.; Yucel, S. (Syracuse Univ., NY (USA)). 26 Mar 1985. Contract FG02-84ER53179. 34p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85009415.

Optimum production and utilization of spin-polarized deuterium as a fusion fuel requires long nuclear spin-lattice relaxation times at temperatures near 4K. This can be achieved with very high purity ortho-D_2. We report new experimental methods and results of total-adsorption catalysis of D_2 para-ortho conversion in the 4 to 15K temperature region, using as catalysts activated alumina and partially-activated charcoal. Because of the strongly anisotropic adsorbate binding on alumina, the ortho-D_2 equilibrium concentration near 10 to 12K (where the conversion time is acceptable) is not high enough, and near 4K (where the equilibium ortho-D_2 concentration is satisfactory) the conversion time is almost prohibitively too long to permit achievement of the desired ortho-D_2 purity. Although doping alumina with paramagnetic ions could improve this situation, it would be at the expense of excessive back-conversion upon desorption.

32993 (DOE/OR/21400—T125) Confinement experiments on ISX-B. Wootton, A.J. (Oak Ridge National Lab., TN (USA)). [1985]. Contract AC05-84OR21400. 35p. NTIS MF A01; 2; GPO Dep. File Number DE85012346.

The following topics are discussed: (1) direction of the experimental program, (2) status as of November 1982, (3) how to improve confinement, and implications for scaling of electron thermal diffusivity, (4) balanced beam injection, and (5) electric fields. (MOW)

32994 (DP-MS—84-129) Tritium-helium effects in metals. Caskey, G.R. Jr. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1985. Contract AC09-76SR00001. 20p. (CONF-850405—8). NTIS, PC A02/MF A01; GPO Dep. File Number DE85011507.

From 2. national topical meeting on tritium technology in fission, fusion and isotopic applications; Dayton, OH, USA (30 Apr 1985).

Investigations of helium effects in metals at the Savannah River Laboratory have been carried out by introducing helium by radioactive decay of tritium. This process does not create concurrent radiation damage, such as accompanies ion implantation and (n,α) reactions. The process has its own peculiarities, however, which partially mask and interact with the helium effect of interest. The distribution and local concentration of helium and tritium, which are responsible for changes in mechanical properties and fracture mode, are controlled by the large difference in solubility and diffusivity between the two atoms and by their differing interaction energies with lattice defects, impurities, and internal boundaries. Furthermore, in all investigations with helium generated from tritium decay, some tritium and deuterium are always present. Consequently, property changes include tritium-helium interaction effects to some extent. Results of investigations with several austenitic stainless steels, Armco iron, and niobium single crystals illustrate the variety of phenomena and some of the complex interactions that can be encountered.

32995 (EGG—2393) Survey of element and isotope importance for fusion safety and environmental assessments. Piet, S.J. (EG and G Idaho, Inc., Idaho Falls (USA)). May 1985. Contract AC07-76ID01570. 34p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85012415.

A survey was made, using the most reliable information possible, to identify which elements and isotopes are potentially important for fusion safety and environmental assessments. It was determined that 51 elements may be exposed to fusion neutrons in either experimental devices or commercial reactors. These elements were prioritized by the relative probability of use. Also, 371 radioactive isotopes were identified that may be produced from these elements. These isotopes were prioritized by screening criteria that measured their relative importance to effluent assessments, accident assessments, and waste management assessments. Survey results presented in this report are prioritized lists of elements and isotopes of importance to neutronics researchers, effluent assessors, accident assessors, waste management assessors, maintenance assessors, and volatility and/or transport researchers. It is hoped that the results of this effort will lead to improved information in the various area, which in turn will lead to better safety and environmental assessments.

32996 (HEDL-TME—84-29) Experimental lithium system. Final report. Kolowith, R.; Berg, J.D.; Miller, W.C. (Hanford Engineering Development Lab., Richland, WA (USA)). Apr 1985. Contract AC06-76FF02170. 326p. NTIS, PC A15/MF A01; GPO Dep. File Number DE85013252.

A full-scale mockup of the Fusion Materials Irradiation Test (FMIT) Facility lithium system was built at the Hanford Engineering Development Laboratory (HEDL). This isothermal mockup, called the Experimental Lithium System (ELS), was prototypic of FMIT, excluding the accelerator and dump heat exchanger. This 3.8 m^3 lithium test loop achieved over 16,000 hours of safe and reliable operation. An extensive test program demonstrated satisfactory performance of the system components, including the HEDL-supplied electromagnetic lithium pump, the lithium jet target, the purification and characterization hardware, as well as the auxiliary argon and vacuum systems. Experience with the test loop provided important information on system operation, performance, and reliability. This report presents a complete overview of the entire Experimental Lithium System test program and also includes a summary of such areas as instrumentation, coolant chemistry, vapor/aerosol transport, and corrosion.

32997 (IA—1404, pp 44-45) High energy-multiplication blankets for cat-D fusion reactors. Greenspan, E.; Karni, Y. Jul 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85780940.

Published in summary form only.
In Research laboratories annual report 1983.

32998 (IA—1404, pp 45-47) Optimal shields for fusion reactors. Gilai, D.; Greenspan, E.; Levin, P. Jul 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85780940.

Published in summary form only.
In Research laboratories annual report 1983.

32999 (IA—1404, pp 47-48) Denaturing plutonium with fusion breeders. Greenspan, E.; Kinrot, A. Jul 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85780940.

Published in summary form only.
In Research laboratories annual report 1983.

33000 (IA—1404, pp 43-44) Promise of fusion breeders. Greenspan, E. (Israel Atomic Energy Commission, Tel Aviv); Miley, G.H. (Illinois Univ., Urbana (USA)). Jul 1984. NTIS (US Sales Only), PC A13/MF A01. File Number DE85780940.

Published in summary form only.
In Research laboratories annual report 1983.

33001 (INIS-mf—9429) Hybrid fusion-fission reactors. Thomas, J.B. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service d'Etudes des Reacteurs et de Mathematiques Appliquees). 1983. 24p. (In French). (CONF-8306262—1). NTIS (US Sales Only), PC A02/MF A01. File Number DE85780918.

From Belgian Nuclear Society annual meeting on advanced uses of accelerators on the nuclear fuel cycle; Brussels, Belgium (13 Jun 1983).

After a review of the different possibilities of the concept of hybrid reactor, the article considers as an example a reactor whose source is a small size Tokamak with a D.T. fusion cycle. The principles of such a reactor, its potential, the main parameters having an effect on its performance and its feasibility as well as the economic parameters are discussed. (AF).

33002 (IPF—83-8) Multihole couplers for overmoded waveguide systems. Janzen, G.; Stickel, H. (Stuttgart Univ. (Germany, F.R.). Inst. fuer Plasmaforschung). Dec 1983. 29p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85780964.

Directional couplers for transverse electric (TE) modes are described which selectively pick one mode from a mode mixture in an overmoded circular waveguide system. Unwanted modes are statistically nulled out in the coupling waveguide. Mode selectivity and directivity oscillate up and down with an increasing number of holes and finally reach approximately the 20 dB mark. A directional coupler for the TE_{02} mode (28 GHz, 63.4 mm circular waveguide) with 41 holes and a length of 1.6 m shows a directivity of 68 dB and suppresses TE_{01} with 58 dB, TE_{03} with 28 dB, TE_{04} with 34 dB, TE_{22} with 37 dB, and further modes TEsub(lm)(l<5, m<6) with 17 dB to 34 dB.

33003 (IPF—83-9) Short mode selective directional couplers. Janzen, G.; Stickel, H. (Stuttgart Univ. (Germany, F.R.). Inst. fuer Plasmaforschung). Dec 1983. 22p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85780963.

Short mode selective directional couplers for transverse electric (TE) modes travelling in overmoded circular waveguides are described. Directivity is achieved by pairs of holes with destructive interference in backward direction, unwanted modes are suppressed by destructive interference in either directions of the coupling guide. A 28 GHz narrow directional coupler for the TE_{01} mode (63.4 mm waveguide diameter) with 16 holes and a length of 230 mm shows a directivity of 55 to 100 dB between 27.9 and 28.1 GHz, suppressing the TE_{02} mode with 35 to 80 dB, the TE_{03} mode with 30 to 65 dB, and the TE_{22} mode with 30 to 70 dB.

33004 (IPF—84-5) Electron cyclotron resonance heating system for the stellarator W VII-AS. Wilhelm, R.; Erckmann, V.; Janzen, G.; Kasparek, W.; Mueller, G.; Schueller, P.G.; Schwoerer, K.; Thumm, M. (Stuttgart Univ. (Germany, F.R.). Inst. fuer Plasmaforschung). Jul 1984. 29p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85780961.

Review and discussion of the physical and technical aspects of the W VII-AS ECRH system are presented.

33005 (IPF—84-6) High-power millimeter-wave mode converters in overmoded circular waveguides using periodic wall perturbations. Thumm, M. (Stuttgart Univ. (Germany, F.R.). Inst. fuer Plasmaforschung). Jul 1984. 40p. (CONF-8407120—1). NTIS (US Sales Only), PC A03/MF A01. File Number DE85780960.

From International symposium on gyrotron development; Lausanne, Switzerland (4 Jul 1984).

This work reports on measurements and calculations (coupled mode equations) on the conversion of circular elecric TEsub(0n) gyrotron mode compositions (TE_{01} to TE_{04}) at 28 and 70 GHz to the linearly polarized TE_{11} mode by means of a mode converter system using periodic waveguide wall perturbations. Mode transducers with axisymmetric radius perturbations transform the TEsub(0n) gyrotron mode mixture to the more convenient TE_{01} mode for long-distance transmission through overmoded waveguides. Proper matching of the phase differences between the TEsub(0n) modes and of lengths and perturbation amplitudes of the several converter sections is required. A mode converter with constant diameter and periodically perturbed curvature transfers the unpolarized TE_{01} mode into the TE_{11} mode which produces an almost linearly polarized millimeter-wave beam needed for efficient electron cyclotron heating (ECRH) of plasmas in thermonuclear fusion devices. The experimentally determined TEsub(0n)-to-TE_{01} conversion efficiency is (98+-1)% at 28 and 70 GHz (99% predicted) while the TE_{01}-to-TE_{11} converter has a (96+-2)% conversion efficiency at 28 GHz (95% predicted) and (94+-2)% at 70 GHz (93% predicted); ohmic losses are included.

33006 (IPF—84-9) Wave absorption and transport studies on ECR heated stellarator plasmas in W VII-A. Erckmann. V.; Janzen, G.; Kasparek, W.; Mueller, G.; Raeuchle, E.; Schueller, P.G.; Schwoerer, K.; Thumm, M.; Wilhelm, R.; Dorst, D. (Stuttgart Univ. (Germany, F.R.). Inst. fuer Plasmaforschung). Sep 1984. 15p. (CONF-840910—27; IAEA-CN—44/D-I-5). NTIS (US Sales Only), PC A02/MF A01. File Number DE85780959.

From 10. international conference on plasma physics and controlled nuclear fusion research; London, UK (12 Sep 1984).

OH-current free stellarator plasmas with attractive parameters could be produced by irradiating intense, linearly polarized ECR waves into W VII-A. These waves were launched in O-mode orientation from the torus outside in the TE_{11} or HE_{11} mode. The localized power deposition results in a very narrow electron temperature profile, but it also allows profile shaping by choosing off-axis EC resonance. The total absorption agrees well with single-pass O-mode absorption, even at extreme power densities and at conditions of fully relativistic absorption. In contrast to theoretical expectations, the reflection of the non-absorbed O-mode power in X-mode orientation did not improve the overall heating efficiency, however. Optimum confinement of the stellarator plasma in W VII-A is achieved at irrational t-values. At these optimum conditions the electron energy transport in the ECRH-sustained plasma can be described by three main contributions: axisymmetric neoclassical transport in the central region, neoclassical losses due to the helical ripple at LMFP conditions in the intermediate zone, and anomalous losses dominating in the edge region.

33007 (IPP—1/234) Investigation of tritium removal by means of organic compounds. Catalytic hydrogenation (tritiation) of linoleic acid. El-Sharnouby, A.; Weichselgartner, H. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). Nov 1984. 20p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85751653.

In the presence of noble-metal catalysts unsaturated fatty acids such as eruic acid and linoleic acid capture hydrogen (and tritium) quantitatively. The hydrogenation reaction of eruic acid has already been reported. The experimental results of the reaction of hydrogen (and tritium) with linoleic acid are now discussed in this paper. Obviously, the use of linoleic acid shows some advantages compared with eruic acid: - the hydrogenation reaction is faster, - linoleic acid is liquid, so that the choice of additional solvents is easier, and - linoleic acid is a more or less cheap natural product, which is available from a series of seeds, so that the cost of a technical tritium removal plant is not increased by the basic chemical material.

33008 (IPP—4/218) Description of the low-power part of the RF-System for the Lower-Hybrid experiments in ASDEX. Zouhar, M. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). Feb 1984. 24p. (In German). NTIS (US Sales Only), PC A02/MF A01. File Number DE85780965.

A description of the 1.3 GHz RF-System for the Lower-Hybrid experiments in ASDEX is given including the RF-part of the data acquisition system. Special emphasis is devoted to the amplitude- and phase-regulating system.

33009 (IPP—III/97) Time and space-resolved energy flux measurements in the divertor of the ASDEX tokamak by computerized infrared tomography. Mueller, E.R.; Steinmetz, K.; Bein, B.K. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). Jun 1984. 52p. NTIS (US Sales Only), PC A04/MF A01. File Number DE85780955.

A new, fully computerized and automatic thermographic system has been developed. Its two central components are an AGA THV 780 infrared camera and a PDP-11/34 computer. A combined analytical-numerical method of solving the 1-dimensional heat diffusion equation for a solid of finite thickness bounded by two parallel planes was developed. In high-density (anti nsub(e) = 8 x 10^{13} cm^{-3}) neutral-beam-heated (L-mode) divertor discharges in ASDEX, the power deposition on the neutralizer plates is reduced to about 10-15% of the total heating power, owing to the inelastic scattering of the divertor plasma from a neutral gas target. Between 30% and 40% of the power is missing in the global balance. The power flow inside the divertor chambers is restricted to an approximately 1-cm-thick plasma scrape-off layer. This width depends only weakly on the density and heating power. During H-phases free of Edge Localized Mode (ELM) activity the energy flow into the divertor is blocked. During H-phases with ELM activity the energy is expelled into the divertor in very short intense pulses (several MW for about one hundred μs). Sawtooth events are able to transport significant amounts of energy from the plasma core to the peripheral zones and the scrape-off layer, and they are frequently correlated with transitions from the L to the H mode.

33010 **(JAERI-M—83-230) Electrical resistivity change in Cu and Al stabilizers of superconducting magnets after low-temperature neutron irradiation.** Nakata, Kiyotomo; Tada, Naobumi; Masaoka, Isao; Takamura, Saburo. (Japan Atomic Energy Research Inst., Tokyo). Jan 1984. 35p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. File Number DE85700997.

Copper(Cu) and aluminum(Al) are candidate materials for a stabilizer of a superconducting magnet in a fusion reactor. These materials are irradiated by fast neutrons at about 5K and annealed to 300K, and the repeated irradiations are performed. The change in the magnetoresistivity at 4.2K after the irradiation and after the annealing is measured and the effect of cold work and purity of materials is studied. The following results are obtained: 1) The resistivity increase by irradiation in Al is about three times larger than that in Cu. 2) After 300K anneal, about 20% of the radiation induced resistivity in Cu remains and the radiation induced resistivity in Al annihilates. 3) The radiation induced resistivity in cold worked Cu with R.R.R. of 300 is equal to that in annealed one. The amount of radiation induced resistivity remained after 300K anneal (Δ rho sub(ann)) in cold worked Cu is smaller than Δ rho sub(ann) in annealed Cu. 4) The radiation induced magnetoresistivity (Δ rho) of the high purity Cu with R.R.R. of 1400 is larger than that with R.R.R. of 300. Δ rho in the former increases with increasing the magnetic field, while Δ rho in the latter is constant despite the magnetic field. The pre-irradiation resistivity of cold worked Cu is very large as compared with that of annealed one. Therefore, the annealed Cu with R.R.R. of 300 is considered to be the best material as the stabilizer used under irradiation from consideration of above results.

33011 **(JAERI-M—84-011) Evaluation of thermal stress in the anode chamber wall of a Large Volume Magnetic Bucket Ion Source.** Wells, Russell; Horiike, Hiroshi; Kuriyama, Masaaki; Ohara, Yoshihiro. (Japan Atomic Energy Research Inst., Tokyo). Feb 1984. 39p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85700995.

Thermal stress analysis was performed on the plasma chamber of the Large Volume Magnetic Multipole Bucket Ion Source (LVB) designed for use on the JT-60 NBI system. The energy absorbed by the walls of the plasma chambers of neutral beam injectors is of the order of 1% of the accelerator electrical drain power. A previous study indicates that a moderately high heat flux, of about 600W/cm^2, is concentrated on the magnetic field cusp lines during normal full power operation. Abnormal arc discharges during conditioning of a stainless steel LVB produced localized melting of the stainless steel at several locations near the cusps lines. The power contained in abnormal arc discharges (arc spots) was estimated from the observed melting. Thermal stress analysis was performed numerically on representative sections of the copper LVB design for both stable and abnormal arc discharge conditions. Results show that this chamber should not fail due to thermal fatigue stesses arising from normal arc discharges. However, fatigue failure may occur after several hundred to a few thousand arc spots of 30mS duration at any one location. Limited arc discharge operation of the copper bucket was performed to partially verify the chamber's durability.

33012 **(JAERI-M—84-012) Fabrication and testing of a quartz oscillator microbalance.** Hiroki, Seiji; Abe, Tetsuya; Inagawa, Konosuke; Obara, Kenjiro; Murakami, Yoshio. (Japan Atomic Energy Research Inst., Tokyo). Feb 1984. 17p. (In Japanese). NTIS (US Sales Only), PC A02/MF A01. File Number DE85700993.

A quartz oscillator microbalance was developed for continuous measurement of gas adsorption on the first wall of fusion devices. Important factors affecting the frequency stability of the quartz oscillator are electromagnetic noise, temperature change, drive power and capacitance. We studied these problems and fabricated an optimum circuit for the microbalance. Relevant experimental results are also presented.

33013 **(JAERI-M—84-013) In-pile test of tritium release from lithium oxide. An evaluation study on neutronics and thermohydraurics of sweep gas capsule packed with Li_2 O pellets.** Kurasawa, Toshimasa; Yoshida, Hiroshi; Watanabe, Hitoshi. (Japan Atomic Energy Research Inst., Tokyo). Feb 1984. 54p. (In Japanese). NTIS (US Sales Only), PC A04/MF A01. File Number DE85700998.

Material development and blanket design of lithium-based ceramics such as Li_2O, $LiAlO_2$, Li_2SiO_3, Li_2ZrO_3 has been performed to study their applicability to the tritium breeding blanket of a fusion reactor. Especially, the need of the test with regard to tritium release characteristics, material integrity, and neutronics and thermohydraurics of these materials under the operating conditions of the blanket has been emphasized in Japan, US and Europe. Tritium release characteristics of Li_2O pellets under thermal neutron flux were measured by the present work which forms a part of "Irradiation Tests of Lithium Oxide under High Neutron Flux". Irradiation was carried out in a vertical hole of the JRR-2(VT-10 in the fuel rods region, phi sub(th) = 1.0 x 10^{14}, phi sub(f) = 1 x 10^{13} n/cm^2. sec), and total irradiation time was 990hrs. This report describes distributions of reaction rates of $^6Li(n,\alpha)^3H$ and $^7Li(n,n\alpha)^3H$ and temperature of the Li_2O pellets in the sweep gas capsule as well as the effect of induced radioactivity due to impurities in the lithium oxide.

33014 **(JAERI-M—84-034) Type tests of the welded bellows for the ports of the JT-60 vacuum vessel.** Takatsu, Hideyuki; Yamamoto, Masahiro; Shimizu, Masatsugu; Suzuki, Kazuo; Sonobe, Tadashi; Hayashi, Yuzo; Mizuno, Genichiro. (Japan Atomic Energy Research Inst., Tokyo). Mar 1984. 58p. (In Japanese). NTIS (US Sales Only), PC A04/MF A01. File Number DE85700999.

Type tests of three kinds of the welded bellows were carried out to examine their applicability to the ports of the JT-60 vacuum vessel, because strict specifications on the mechanical, vacuum and thermal properties were required for them. The following conclusions were obtained after seven kinds of type tests. (1) Spring constant and stress measurement tests showed a good agreement between the measured values and the calculated ones and confirmed the validity of the spring constant and stress evaluation formula. (2) The results of the Helium leak and outgassing rate measurement tests were found to be below the specifications and showed the good vacuum property of the welded bellows. (3) The welded bellows kept up the structural integrity after the thermal cycle, life and pressure tests and sufficient thermal and mechanical property of the welded bellows was confirmed.

33015 **(JAERI-M—84-062) Design of JT-60 first wall.** Nakamura, Hiroo; Shimizu, Masatsugu; Masuda, Michio; Shimizu, Toru; Ohta, Mitsuru; Miyauchi, Yasuyuki. (Japan Atomic Energy Research Inst., Tokyo). Mar 1984. 56p. (In Japanese). NTIS (US Sales Only), PC A04/MF A01. File Number DE85700994.

This paper describes an outline of JT-60 first wall design. Main purpose of JT-60 is to achieve reactor grade plasma and maintain 5 – 10 sec plasma discharge. Therefore, the requirements from physics and engineering aspects are extremely severe than the one in currently operating tokamak. In FY1974 – 1976, to make clear the points at issue and the technological prospects, a number of examinations and R and D works have been performed. As a result, molybdenum has been selected as a JT-60 first wall material.

Also, toroidal fixed limiter, magnetic limiter plate and liner have been applied as first wall structures. Since a time constant of plasma current decay during a disruption was changed from 50 msec to 1 msec (Target value), liner material was changed to Inconel 625. Mechanical design criterion is based on ASME Section III code. All first wall components are designed to withstand the mechanical load at 3 msec plasma disruption. Design values of heat flux and duration time are 305 w/cm^2 and 10 sec for the toroidal fixed limiter, and 440 w/cm^2 and 5 sec for the magnetic limiter plate, respectively. Interval time between discharges is 10 min. Design values of the maximum surface temperature are 900sup(o)C for molybdenum and 600sup(o)C for Inconel 625, respectively. First wall structure is designed to protect bellows, thermocouples and electromagnetic sensors against severe plasma thermal load. Also, the first wall can be exchanged easily for first wall experiment. Titanium carbide, 20 μm in thick, are coated onto the first wall. Details of the first wall design will be published in another reports.

33016 (JINR-D—2,-13-83-689, pp 101-116) **Lasers for controlled thermonuclear fusion.** Basov, N.G.; Danilychev, V.A. (AN SSR, Moscow. Fizicheskij Inst.). 1983. (In Russian). NTIS (US Sales Only), PC A08/MF A01. File Number DE85780874. (CONF-8306179—).

From Working meeting on problems of radiation and detection of gravitational waves; Dubna, USSR (7 Jun 1983).

Laser system designs for controlled thermonuclear reactor drivers are described. CO_2-lasers and lasers in excimer media are considered. Parameters 1 mJ of KrF laser for CTF and parameters of a high current electron accelerator for 800 kJ energy for pumping the terminal amplification module of the KrF laser are indicated. The laser KrF system comprises 10 KrF-amplifiers producing 150 kJ in a pulse each. Amplifiers are supplied from preamplifiers through 10 beam channels of 100-120 m length. In the ends of beam channels situated are stacker mirrors cousing and eliminating time delay of light pulses which are transmitted then to the Stokes amplifier. The perspectiveness of laser designs on the Xe2 molecule for pumping power laser on the OCSe molecule and chemical lasers on HF and oxygen-iodine is shown.

33017 **(KFK—3608) GORGON - a computer code for the calculation of energy deposition and the slowing down of ions in cold materials and hot dense plasmas.** Long, K.A.; Moritz, N.; Tahir, N.A. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Neutronenphysik und Reaktortechnik). Nov 1983. 150p. NTIS (US Sales Only), PC A07/MF A01. File Number DE85751642.

The computer code GORGON, which calculates the energy deposition and slowing down of ions in cold materials and hot plasmas is described, and analyzed in this report. This code is in a state of continuous development but an intermediate stage has been reached where it is considered useful to document the 'state of the art' at the present time. The GORGON code is an improved version of a code developed by Zinamon et al. as part of a more complex program system for studying the hydrodynamic motion of plane metal targets irradiated by intense beams of protons. The improvements made in the code were necessary to improve its usefulness for problems related to the design and burn of heavy ion beam driven inertial confinement fusion targets.

33018 **(KFK—3875) Stress and lifetime calculations for first wall and blanket structural components. Pt. 1.** Fett, T.; Munz, D. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorbauelemente; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Kernfusion). Jan 1985. 86p. NTIS (US Sales Only), PC A05/MF A01. File Number DE85751640.

In this report the lifetime of first wall and blanket structures of fusion reactors is investigated. The extension of small pre-existing cracks by the cyclic operation of a fusion reactor seems to be the most important failure mode. The special application of the present investigation are tubes acting directly as parts of the first wall and affected by various radiation effects. The outer surface is asymmetrically heated and by combination of thermal extension, swelling, irradiation creep and internal pressure a complex time dependent stress distribution results. Crack growth until failure caused by cyclic operation of the reactor is computed by application of fracture mechanical methods.

33019 **(LA-UR—85-1792) Determination of CTX equilibria.** Knox, S.O.; Barnes, C.W.; Marklin, G.J.; Jarboe, T.R.; Henins, I.; Hoida, H.W.; Wright, B.L. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 6p. (CONF-8505100—7). NTIS, PC A02/MF A01; GPO Dep. File Number DE85012739.

From 7. US symposium on compact toroid research; Santa Fe, NM, USA (21 May 1985).

The method by which we determine the magnetic field equilibrium for CTX in a nonperturbing manner is presented. Measurements of flux conserver image currents are combined with calculations from a numerical model of the equilibrium. Results give equilibria which differ significantly from the minimum energy state, but the equilibria data are well-described by a model where j/B has a linear dependence on the poloidal flux function. The observation of non-disruptive rotating internal kink distortions (with toroidal mode numbers $n = 1$, 2 and 3) within the equilibria and theoretical MHD thresholds for the onset of these modes corroborate the inferred equilibria.

33020 **(LA-UR—85-1818) Energy efficiency of the CTX magnetized coaxial plasma source.** Fernandez, J.C.; Barnes, C.W.; Jarboe, T.R.; Knox, S.O.; Platts, D.A.; McKenna, K.F. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 5p. (CONF-8505100—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE85012735.

From 7. US symposium on compact toroid research; Santa Fe, NM, USA (21 May 1985).

The energy efficiency of the CTX coaxial plasma source in creating spheromaks is determined experimentally to be in agreement with the theoretical prediction of λ/sub sp//λ/sub g/, where del x B = λ/sub sp/ B in the spheromak, and λ/sub g/ identical with μ_0I/sub g//phi/sub g/ with I/sub g/ the source current and phi/sub g/ the magnetic flux through either source electrode. This is shown to be equivalent to magnetic helicity conservation. The spheromak impurity radiation was measured using an absolutely calibrated single chord bolometer system. The theoretical efficiency is within the experimental uncertainty of the ratio of spheromak radiated energy to source input energy in a group of "dirty" discharges. But the radiation measurement uncertainty is too large to determine whether a substantial part of the excess source energy not used in the production of spheromak magnetic energy is radiated from the spheromak volume.

33021 **(LBL—19136) H^- production in a multicusp microwave plasma.** Trow, J.R. (Lawrence Berkeley Lab., CA (USA)). Mar 1985. Contract AC03-76SF00098. 220p. NTIS, PC A10/MF A01; GPO Dep. File Number DE85011983.

Thesis.

An experiment was undertaken to examine H^- production by volume processes in a multicusp microwave discharge, part of the cusp field being enhanced to produce an ECR (electron cyclotron resonance), that would also isolate the hotter plasma formed there. This arrangement is analogous to the "magnetic filters" used in some other negative ion sources. This work describes the experiment set up and the results obtained, which are a survey of the behavior of this type of device. Also included is a discussion of the volume processes associated with H^- production including numerical estimates, based on the experimental measurements, which indicate H^- production is by dissociative attachment of cold electrons to vibrationally excited hydrogen molecules, and loss is by mutual neutralization with positive ions. The experimental observations are consistent with this model. These are also the same mechanisms used in the models of Bacal and Hiskes. Since magnetic fields generated by samarium cobalt permanent magnets were an important part of this experiment a set of field calculations was undertaken and is included.

33022 (LMF—113, pp 3-7) **Fusion reactor inhalation hazards: generation of lithium combustion aerosols.** Allen, M.D.; Greenspan, B.J.; Hoover, M.D. Dec 1984. NTIS, PC A23/MF A01. File Number DE85009283.

In Inhalation Toxicology Research Institute annual report, October 1, 1983-September 30, 1984.

A system was developed for generating lithium aerosols to determine the potential hazards of postulated accidents associated with the use of lithium as a fusion reactor blanket or coolant. The aerosol generation system produced well-controlled concentrations up to 2500 mg/m^3 for periods of four hours. Aerosols could be generated that were greater than 97% Li_2O and LiOH, $LiOH.H_2O$, or Li_2CO_3 by controlling the CO_2 and H_2O concentrations in the supply air. This system is currently being used to investigate the acute toxicity of lithium combustion aerosols in laboratory animals. 3 references, 3 figures.

33023 (LMF—113, pp 8-11) **Studies of beryllium aerosols in fusion-related systems.** Hoover, M.D.; Allen, M.D.; Greenspan, B.J.; Eidson, A.F.; Harmsen, A.G. Dec 1984. NTIS, PC A23/MF A01. File Number DE85009283.

In Inhalation Toxicology Research Institute annual report, October 1, 1983-September 30, 1984.

Beryllium particles produced in several industrial and research activities were investigated to aid in selecting appropriate aerosols for experiments designed to study the potential health hazards from using beryllium in fusion reactor systems. Aerosols of beryllium metal and beryllium oxide were obtained in an industrial machining operation, in laboratory studies using an electron beam and a laser beam, and in a research fusion device. Samples of stock beryllium metal and beryllium oxide powders were also examined. Particles of respirable size were found in all cases. Beryllium particles from powder metallurgy and the particles from machining beryllium metal were irregular in shape, typical of comminution processes. Particles produced at subatmospheric pressures in the electron beam and fusion devices were also irregular in shape and may have resulted from sputtering of beryllium by the plasma or the electron beam. The particles formed by laser vaporization at atmospheric pressure were branched-chain aggregates with individual particles appearing crystalline in shape. 4 references, 1 figure.

33024 (NIRS-M—41, pp 298-318) **Considerations for tritium protection at a fusion reactor.** Easterly, C.E. (Oak Ridge National Lab., TN (USA)). Mar 1982. NTIS (US Sales Only), PC A15/MF A01. File Number DE85781032. (CONF-811082—).

From Workshop on tritium radiobiology and health physics; Chiba, Japan (1 Oct 1981).

The view on the radiological hazard associated with future fusion power stations as presented in this discussion is rarely supported by reasonably certain or reliably accurate prediction. This fact should not be taken as indicating a major programmatic deficiency. In fact, it is expected that large uncertainty would be present in health effect at the current level of technological development. The details of tritium exposure will be clarified, waiting for the operation of the Tritium System Test Assembly. Once the data base for the TSTA is established, future fusion design can be made based on economic cost/radiation exposure risk benefit. The actual execution of this cost/benefit analysis is complex because three populations are of interest: occupational work force, local population and global population. The knowledge of tritium management must be increased if D-T fusion reactors are to become compatible with the needs of utility companies. In order to exploit the differing hazard between HT and HTO, it is necessary to know much more about the mechanism of uncatalyzed conversion over a wide range of concentration and about the change caused by the variety of potential catalytic sequence in potential tritium leak.

33025 (NIRS-M—41) **Proceedings of the workshop on tritium radiobiology and health physics.** Matsudaira, Hiromiohi; Yamaguchi, Takeo; Nakazawa, Tohru; Saito, Chieko (eds.). (National Inst. of Radiological Sciences, Chiba (Japan)). Mar 1982. 326p. (CONF-811082—). NTIS (US Sales Only), PC A15/MF A01. File Number DE85781032.

From Workshop on tritium radiobiology and health physics; Chiba, Japan (1 Oct 1981).

Separate abstracts were entered into the data base for each paper. (MOW)

33026 (NRL-Memo—5591) **Operational window for a plasma erosion opening switch used for voltage multiplication on pulsed power generators.** Ottinger, P.F. (Naval Research Lab., Washington, DC (USA). Plasma Physics Div.). 5 Jun 1985. Contract AI08-79DP40092. 27p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85013088.

The Plasma Erosion Opening Switch (PEOS) is a fast opening switch which has been shown to be capable of conducting megampere-level currents before opening in <10 ns. Such a switch can be used for inductive storage in order to compress the output from conventional pulsed power generator in order to achieve voltage and power multiplication. An operational window is described herein which illustrates the voltage regime made accessible for a given machine by the switch.

33027 (ORNL/Sub—84-95128/1) **140 GHz gyrotron development program. Quarterly report No. 1, March-June 1984.** Felch, K.L.; Bier, R.E.; Craig, L.J.; Fiddaman, T.S.; Fox, L.J.; Hu, G.; Huey, H.E.; Jory, H.R.; Reysner, P.I.; Salop, A. (Varian Associates, Inc., Palo Alto, CA (USA)). 1984. Contract AC05-84OR21400. 83p. NTIS, PC A05/MF A01; GPO Dep. File Number DE85011923.

The objective of this program is to develop a gyrotron oscillator capable of producing 100 kW of CW power at 140 GHz. Most aspects of the conceptual design for the first experimental tube are reported and initial calculations for several critical elements of the second experimental tube are discussed. The specification for the superconducting gyrotron magnet is presented. Finally, the various microwave components, protective devices and special diagnostics required to test the tubes are identified and their design summarized.

33028 (PPPL-Q—41) **Princeton Plasma Physics Laboratory annual report, October 1, 1982-September 30, 1983.** Phillips, C.A. (ed.). (Princeton Univ., NJ (USA). Plasma Physics Lab.). 1983. Contract AC02-76CH03073. 116p. NTIS, PC A06/MF A01; GPO Dep. File Number DE85011971.

The Tokamak Fusion Test Reactor (TFTR) achieved first plasma at 3:05 a.m. on December 24, 1982. During the course of the year, the plasma current was raised to a maximum of 1 MA, and extensive confinement studies were carried out with ohmic-heated plasmas. The most important finding was that tokamak energy confinement time increases as the cube of the plasma size. The Princeton Large Torus (PLT) carried out a number of high-powered plasma-heating experiments in the ion cyclotron frequency range, and also demonstrated for the first time that a 100-kA tokamak discharge can be built up by means of rf-waves in the lower hybrid range, without any need for inductive current drive by the conventional tokamak transformer system. The Poloidal Divertor Experiment (PDX) demonstrated that substantial improvements in plasma confinement during intense neutral-beam heating can be obtained by means of either a magnetic divertor or a mechanical scoop limiter. The S-1 spheromak experiment has come into operation, with first plasma in January 1983, and machine completion in August. The soft X-ray laser development experiment continues to make strong progress towards the demonstration of laser amplification. Thus far, a single-pass gain of 3.5 has been achieved, using the 182 A line of CVI. Theoretical MHD-stability studies have shed new light on the nature of the energetic-ion-driven "fishbone instability," and the utilization of the bean-shaping technique to reach higher beta values in the tokamak.

33029 (RAL—84-049) **Annual report to the Laser Facility Committee 1984.** (Rutherford Appleton Lab., Chilton (UK)). 1984. 377p. NTIS (US Sales Only), PC A17/MF A01. File Number DE85700996.

The report describes the work carried out at, or in association with, the Central Laser Facility (CLF), during the year ending March 1984. The CLF programme is divided into three main sections. The first, the glass laser scientific programme, is concerned with applications of the high power Nd glass laser. The second, the ultra violet radiation facility scientific programme, involves the excimer pumped frequency tunable lasers. The last, high power KrF laser development, describes Research and development work on this laser.

33030 (SAND—84-0159) Technical assessment of thermal-hydraulics for high heat flux fusion components. Boyd, R.D.; Wong, C.P.C.; Cha, Y.S. (Sandia National Labs., Albuquerque, NM (USA); GA Technologies, Inc., San Diego, CA (USA); Argonne National Lab., IL (USA)). Jan 1985. Contract AC04-76DP00789. 77p. NTIS, PC A05/MF A01; GPO Dep. File Number DE85013178.

This report is a technical assessment of three possible thermal-hydraulic high heat flux (HHF) heat removal techniques which will result in adequate heat removal from fusion components with minimum penalty. The heat removal alternatives discussed in detail are: (1) subcooled flow boiling (SFB) with water; (2) high velocity helium gas convection (HGC); and (3) liquid metal (LM) heat transfer in the presence of a transverse magnetic field (TM). Advantages and disadvantages of each technique are delineated. Each heat removal technique is examined for a case study applicable to near-term fusion components such as limiters and divertors. Other HHF removal alternatives are briefly compared with these three alternatives. The results can be used, along with other fusion component performance constraints, to determine the research and development direction of generic problems such as HHF removal from fusion components in both near-term or existing fusion reactors (e.g., TFTR, TEXTOR, D-III, MFTF-B and compact reactors) and long-term or proposed reactors (e.g., TFCX and BCX). Specifically, comparisons are made for the selected case study of heat removal from a 1.5 m long, 1.0 cm diameter (inside) coolant channel which is subjected to a uniform steady-state heat flux of 0.5 kW/cm^2. The results show that SFB has the greatest heat removal capability, with the lowest coolant channel wall temperature and pumping power, followed by HGC and LMTM. Critical research and development needs for each HHF removal technique are also summarized.

33031 (SAND—84-1654) PMEXA: diagnostic filtering program for the PBFA-I performance monitoring and evaluation system. Phillips, A.R.; VanDevender, J.P. (Sandia National Labs., Albuquerque, NM (USA)). May 1985. Contract AC04-76DP00789. 84p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85013179.

An automatic analysis program PMEXA has been developed to analyze and correlate the data on many PBFA I shots to determine the random timing variations, the systematic dependences of components on the operation of the previous stages, and the deviations of major components from normal operation. As an example, the analysis can uncover performance deviations of 1 to 2 ns out of data dominated by typically 3-ns standard deviation jitter, 3-ns standard deviation component defects, and 25% flow-through timing variations from previous stages. The defects are identified for operations personnel to investigate and, hence, the program filters the number of events that require attention.

33032 (SAND—84-2434C) Providing automated control for PBFA-II. Italiano, V.M. (Sandia National Labs., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 10p. (CONF-850616—10). NTIS, PC A02/MF A01; GPO Dep. File Number DE85012867.

From 5. IEEE pulsed power conference; Washington, DC, USA (10 Jun 1985).

Four levels of control are available to the operator in the Particle Beam Fusion Accelerator II (PBFA-II) control/monitor system. At the lowest control level, remote manual, the operator is responsible for all accelerator control and coordination. He is also responsible for interpreting sensor and actuator values to determine the state of the accelerator. At the highest control level, auto-staging, the computer integrates the sensor and actuator values into reports it presents to the operator. The operator can control several accelerator subsystems with single auto-staging commands that the control/monitor system interprets into sequences of integrated functions. The control system is being implemented from the bottom up, from remote manual to auto-staging - but will not be completed until well into the characterization phase of the PBFA-II project. Control action tasks are being integrated now with no major changes to the control/monitor design. Once the control action tasks are completely implemented no more changes are expected in the design. The higher level control systems should be easily implemented. This paper is an overview of the control/monitor system and will discuss each control level of the system.

33033 (SAND—84-2519C) Advances in data acquisition system technology for PBFA II. Boyer, W.B.; Bouchier, F.A.; Ezell, T.F.; Mattson, C.R.; Newcom, C.C. (Sandia National Labs., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 14p. (CONF-850616—30). NTIS, PC A02/MF A01; GPO Dep. File Number DE85012860.

From 5. IEEE pulsed power conference; Washington, DC, USA (10 Jun 1985).

The data acquisition system being built for PBFA II incorporates several new advanced technology features. The system will have 80 new waveform recorders with a 1.35 GHz sampling rate, 250 MHz bandwidth and 10,000 sample record length. A fast analog multiplexer will be used to enable recording multiple signals on each recorder. The accelerator performance monitor system will use time interval digitizers with a time window of +- 8 msec. This long window and the pretrigger feature will provide data for a thorough analysis of accelerator prefires. The calibration system will automatically route precision dc levels, sine waves and fast-rise pulses to the waveform recorders. The waveform recording system is being characterized using special multi-channel, high-level simultaneous pulse generators. The system computer has a 32-bit CPU, 350 Mbytes of disc storage and a virtual memory operating system. All software is being written in Fortran 77.

33034 (SAND—84-2520C) Operations considerations in designing a high speed multi-channel data acquisition system. Bouchier, F.A.; Mattson, C.R. (Sandia National Labs., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 13p. (CONF-850616—27). NTIS, PC A02/MF A01; GPO Dep. File Number DE85012840.

From 5. IEEE pulsed power conference; Washington, DC, USA (10 Jun 1985).

Several unique features are being implemented in the PBFA-II DAS. Set up efficiency has been improved by a cable harness that easily allows any of over 700 signals to be cabled to more than 100 waveform channels. Flexibility has been increased by a trigger and fiducial patch panel switching system that quickly enables any of the 18 triggers and fidus to be connected to any of the waveform channels. Reliability has been improved by a specially designed cooling system and a modular system design approach.

33035 (SAND—84-2523C) Model that predicts pulse charged gas switching breakdown phenomena. Martin, T.H. (Sandia National Labs., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 44p. (CONF-850616—21). NTIS, PC A03/MF A01; GPO Dep. File Number DE85013119.

From 5. IEEE pulsed power conference; Washington, DC, USA (10 Jun 1985).

This paper uses the pulsed power switching data to develop a new model of gas switching. The extended model explains such diverse phenomena as prefire probabilities, breakdown voltages, triggered switching delays, triggered breakdown mechanisms, and effects of electrode surface finish on gap breakdown in pulse-charged switches.

33036 (SAND—84-2537C) Implementing the automated features of the PBFA-I control/monitor system. Spiller, J.L. (Sandia National Labs., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 16p. (CONF-850616—29). NTIS, PC A02/MF A01; GPO Dep. File Number DE85012841.

From 5. IEEE pulsed power conference; Washington, DC, USA (10 Jun 1985).

A control system is being provided for PBFA-I, an operational accelerator, to control subsystem functions such as sequencing of oil, water, gas, and vacuum controls, to coordinate charging and firing sequences, and to control safe and idle modes of the machine. Important design concepts in automating this system are: reliability, flexibility, and operability. Reliability is a primary criterion for executing single pulsed power and physics experiments as well as for supporting extended experimental series without a failure that would cause downtime. Flexibility to respond to changes in operating parameters and experimenter needs is being implemented in two major areas: a modular I/O system to provide hardware flexibility,

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and structured software to ease software maintenance. Operability is increased with user-friendly software, and automatic sequencing.

33037 **(SAND—84-2559C) Supermite vacuum interface design.** Moore, W.B.; Stinnett, R.W.; McDaniel, D.H. (Sandia National Labs., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 12p. (CONF-850616—11). NTIS, PC A02/MF A01; GPO Dep. File Number DE85012861.

From 5. IEEE pulsed power conference; Washington, DC, USA (10 Jun 1985).

A new water-plastic-vacuum interface has been designed for Sandia Laboratory's Supermite (2.8 MV, 2.2 ohm) accelerator. This design was based on the PBFA I vacuum interface. Electrostatic field plots show that in positive polarity the water feed to the PBFA I interface will fail at 2 MV on Supermite. This is confirmed by positive polarity experiments and field plots using the PBFA I style vacuum interface at the Naval Research Labs. Modifications to the water section geometry to increase the water breakdown strength in positive polarity result in equivalent electric field grading at the plastic-vacuum interface but allow positive polarity operation at voltages up to 3.1 MV. This is accomplished by incorporating a dielectric field shaper which significantly improves the electric field grading across the insulator.

33038 **(SAND—84-2560C) Design and optimization of the PBFA II vacuum interface and transmission lines for light ion fusion.** McDaniel, D.H.; Stinnett, R.W.; Gray, E.W. (Sandia National Labs., Albuquerque, NM (USA); Cornell Univ., Ithaca, NY (USA)). 1985. Contract AC04-76DP00789. 22p. (CONF-850616—5). NTIS, PC A02/MF A01; GPO Dep. File Number DE85012809.

From 5. IEEE pulsed power conference; Washington, DC, USA (10 Jun 1985).

The PBFA II vacuum insulator was originally designed for optimum coupling to a proton ion diode with minimum inductance. In July 1983 it was decided that lithium ions at 30 MeV would be the baseline for PBFA II. This requires the use of Plasma Opening Switches (POS) and vacuum inductor to reach 30 MV. To achieve this, the vacuum magnetically insulated transmission lines had to be redesigned as an inductive energy store. To gain optimum coupling to this vacuum inductor, the output impedance of the water section was increased by the use of a water-dielectric transformer. The calculations leading to the final design will be discussed.

33039 **(SAND—85-0945C) Light ion sources for ICF.** Gerber, R.A.; Bieg, K.W.; Burns, E.J.T.; Dreike, P.L.; Maenchen, J.; Mehlhorn, T.A.; Olsen, J.N.; Pregenzer, A.L.; Rice, J.K.; Sweeney, M.A. (Sandia National Labs., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 11p. (CONF-850504—26). NTIS, PC A02/MF A01; GPO Dep. File Number DE85011544.

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

PBFA II, Sandia National Laboratories' (SNLA) advanced light-ion accelerator (now under construction), will deliver a 30-MV, 5 MA lithium ion beam to an Inertial Confinement Fusion (ICF) target. Although most ICF experiments have been performed with proton beams, lithium ions were selected for PBFA II for several reasons. The use of lithium enables a large anode-cathode spacing, resulting in less impedance change during the pulse. Lithium ions have less magnetic deflection in the diode, so they can be focused for a longer period of time. Also, since the ionization potential of Li^{+} is low, while that of L^{++} is very large, a Li^{+} source should be achievable without significant contamination from Li^{++}. Ions heavier than Li^{+} would require operating voltages greater than 30 MV, or the ions would have to be accelerated in a multiple charged state.

33040 **(UCID—20153) Helium-cooled molten-salt fusion breeder.** Moir, R.W.; Lee, J.D.; Fulton, F.J.; Huegel, F.; Neef, W.S. Jr.; Sherwood, A.E.; Berwald, D.H.; Whitley, R.H.; Wong, C.P.C.; Devan, J.H. (Lawrence Livermore National Lab., CA (USA); TRW Energy Development Group, Redondo Beach, CA (USA); GA Technologies, Inc., San Diego, CA (USA); Oak Ridge National Lab., TN (USA); Bechtel Group, Inc., San Francisco, CA (USA)). Dec 1984. Contract W-7405-ENG-48. 210p. NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE85012833.

We present a new conceptual design for a fusion reactor blanket that is intended to produce fissile material for fission power plants. Fast fission is suppressed by using beryllium instead of uranium to multiply neutrons. Thermal fission is suppressed by minimizing the fissile inventory. The molten-salt breeding medium (LiF + BeF_2 + ThF_4) is circulated through the blanket and to the on-line processing system where ^{233}U and tritium are continuously removed. Helium cools the blanket and the austenitic steel tubes that contain the molten salt. Austenitic steel was chosen because of its ease of fabrication, adequate radiation-damage lifetime, and low corrosion by molten salt. We estimate that a breeder having 3000 MW of fusion power will produce 6500 kg of ^{233}U per year. This amount is enough to provide makeup for 20 GWe of light-water reactors per year or twice that many high-temperature gas-cooled reactors or Canadian heavy-water reactors. Safety is enhanced because the afterheat is low and blanket materials do not react with air or water. The fusion breeder based on a pre-MARS tandem mirror is estimated to cost $4.9B or 2.35 times a light-water reactor of the same power. The estimated cost of the ^{233}U produced is $40/g for fusion plants costing 2.35 times that of a light-water reactor if utility owned or $16/g if government owned.

33041 **(UCLA/PPG—860) ECH tokamak.** Firestone, M.A.; Mau, T.K.; Conn, R.W. (California Univ., Los Angeles (USA). Center for Plasma Physics and Fusion Engineering). Apr 1985. Contract AT03-80ER52061. 13p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85012074.

A small steady-state tokamak capable of producing power in the 100 to 300 MWe range and relying on electron cyclotron RF heating (ECH) for both heating and current drive is described. Working in the first MHD stability regime for tokamaks, the approach adheres to the recently discovered maximum beta limit. An appropriate figure of merit is the ratio of the fusion power to absorbed RF power. Efficient devices are feasible at both small and large values of fusion power, thereby pointing to a development path for an attractive commercial fusion reactor.

33042 **(UCRL—15663) Microwave modeling of laser plasma interactions. Final report.** (TRW Defense and Space Systems Group, Redondo Beach, CA (USA)). Aug 1983. Contract W-7405-ENG-48. 33p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85012970.

For a large laser fusion targets and nanosecond pulse lengths, stimulated Brillouin scattering (SBS) and self-focusing are expected to be significant problems. The goal of the contractual effort was to examine certain aspects of these physical phenomena in a wavelength regime ($\lambda \sim 5$ cm) more amenable to detailed diagnostics than that characteristic of laser fusion ($\lambda \sim 1$ micron). The effort was to include the design, fabrication and operation of a suitable experimental apparatus. In addition, collaboration with Dr. Neville Luhmann and his associates at UCLA and with Dr. Curt Randall of LLNL, on analysis and modelling of the UCLA experiments was continued. Design and fabrication of the TRW experiment is described under "Experiment Design" and "Experimental Apparatus". The design goals for the key elements of the experimental apparatus were met, but final integration and operation of the experiment was not accomplished. Some theoretical considerations on the interaction between Stimulated Brillouin Scattering and Self-Focusing are also presented.

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33043 (UCRL—15672) Novette diagnostic support. Final report. Cirigliano, R.; Franco, E.; Koppel, L.; Rodrigues, B.; Smith, J. (Advanced Research and Applications Corp., Sunnyvale, CA (USA)). Feb 1985. Contract W-7405-ENG-48. 193p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE85012937.

The primary research areas were the following: (1) contribute x-ray diagnostic, experimental, and data reduction and analysis support for the Novette DANTE x-ray spectrometer experiments. This effort was expanded to improve the overall quality of the Novette database; (2) experimental and calculational characterization of the x-ray imaging properties of an ellipsoidal x-ray collection optic serving as a sensitivity enhancing component of the Transmission Grating Streak Spectrometer; (3) performance simulation of the x-ray dispersion properties of candidate x-ray laser cavity, normal incidence end-mirror optics; (4) contribute x-ray diagnostic, experimental, and data reduction and analysis support for the Novette Henway crystal spectrometer and the MCPIGS microchannel plate intensified grazing incident spectrometer experiments; and (5) perform a technical performance vs cost evaluation of commercially available hardware required to perform the NOVA neutron time-of-flight experiments.

33044 (UCRL—91499-Rev.1) Ultraviolet radiation-damage absorption peak in solid deuterium-tritium. Revision 1. Fearon, E.M.; Tsugawa, R.T.; Souers, P.C.; Poll, J.D.; Hunt, J.L. (Lawrence Livermore National Lab., CA (USA); Guelph Univ., Ontario (Canada)). 1985. Contract W-7405-ENG-48. 8p. (CONF-850405—10-Rev.1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85012969.

From 2. national topical meeting on tritium technology in fission, fusion and isotopic applications; Dayton, OH, USA (30 Apr 1985).

An ultraviolet absorption peak has been seen in solid deuterium-tritium and hydrogen-tritium at a sensor temperature of 5 K. The peak occurs at 3.6 eV and is about 1.5 eV wide. It bleaches out when the temperature is raised to about 10 K but reappears upon cooling and is, therefore, radiation induced. At 5 K, the peak forms on a time scale of minutes and appears to represent part-per-million levels of electron-mass defects. The suggested model is that of a trapped electron, where the peak is the ground state-to-the-conduction band transition. A marked isotope effect is seen between D-T and H-T.

33045 (UCRL—91968) Numerical studies of high current beam compression in heavy ion fusion. Bisognano, J.; Lee, E.P.; Mark, J.W.K. (Lawrence Berkeley Lab., CA (USA); Lawrence Livermore National Lab., CA (USA)). 10 May 1985. Contract W-7405-ENG-48. 5p. (CONF-850504—40). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85011874.

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

The process of longitudinal compression of a drifting heavy ion pulse to be used as an ICF driver is examined with the aid of particle simulation. Space charge forces play a vital role in halting compression before the final focus lens system is reached. This must take place with minimal growth of transverse emittance and momentum spread. Of particular concern is the distortion of longitudinal phase space by the rounded transverse profile of the longitudinal self-electric field.

33046 (UCRL—92538) Theoretical aspects of magnetic helicity. Hammer, J.H. (Lawrence Livermore National Lab., CA (USA)). 15 Apr 1985. Contract W-7405-ENG-48. 12p. (CONF-8503137—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE85011846.

From IAEA technical committee meeting on advances in compact toroid research; Sydney, Australia (4 Mar 1985).

33047 Particle simulations of the low-α Pierce diode. Crystal, T.L.; Kuhn, S. (Electronics Research Laboratory, University of California, Berkeley, California 94720). *Physics of Fluids;* **28**: No. 7, 2116-2124(Jul 1985). Contract AT03-76ET53064.

The evolution of small initial perturbations of the uniform equilibrium of the "classical" Pierce diode [J. Pierce, J. Appl. Phys. 15, 721 (1944)] is studied using particle simulations. These simulations have been performed with the new bounded-plasma code PDW1 [Wm. S. Lawson (private communication)] and cover the parameter range $0<\alpha<3\pi$, where $\alpha = \omega$/sub p/L/v_0. In the linear regime, three stages (initial transit, adjustment, and dominant eigenmode) are distinguished; oscillation frequencies, growth/damping rates, and potential profiles of the dominant eigenmode as well as oscillation frequencies of the next-to-dominant eigenmode are recovered and shown to agree quantitatively with recent analytical results. In the linearly unstable cases, the system evolves nonlinearly to a final state which may be either a new, nonuniform dc equilibrium, or a state of large-amplitude oscillations. In particular, for $\alpha = 1.5\pi$ the character of the final state is found to depend on the details of the initial conditions.

33048 Magnetic alignment of the Tara tandem mirror. Post, R.S.; Coleman, J.W.; Irby, J.H.; Olmstead, M.M.; Torti, R.P. (Plasma Fusion Center, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Review of Scientific Instruments;* **56**: No. 6, 1139-1150(Jun 1985).

Techniques developed for the alignment of high-energy accelerators have been applied to the alignment of the Tara tandem mirror magnetic confinement device. Tools used were: a transit/laser surveyor's system for establishing an invariant reference; optical scattering from ferromagnetic crystallites for establishing magnetic centers in the quadrupole anchor/transition modules; an electron-optical circle-generating wand for alignment of the solenoidal plug and central cell modules; and four differently configured electron emissive probes, including a 40-beam flux mapping e gun, for testing the alignment of the coils under vacuum. Procedures are outlined, and results are given which show that the magnetic axes of the individual coils in the Tara set have been made colinear with each other and with the reference to within +- 1.0 mm over the length of the machine between the anchor midplanes.

33049 Repeating pneumatic hydrogen pellet injector for plasma fueling. Combs, S.K.; Milora, S.L.; Foust, C.R.; Foster, C.A.; Schuresko, D.D. (Lawrence Livermore National Laboratory, University of California, P.O. Box 808, Livermore, California 94550). *Review of Scientific Instruments;* **56**: No. 6, 1173-1178(Jun 1985). Contract AC05-84OR21400.

A repeating pneumatic pellet injector has been developed for plasma fueling applications. The repetitive device extends pneumatic injector operation to steady state. The active mechanism consists of an extruder and a gun assembly that are cooled by flowing liquid-helium refrigerant. The extruder provides a continuous supply of solid hydrogen to the gun assembly, where a reciprocating gun barrel forms and chambers cylindrical pellet from the extrusion; pellets are then accelerated with compressed hydrogen gas (pressures up to 125 bar) to velocities < or =1.9 km/s (1.6 km/s for deuterium pellets). The gun assembly design can accommodate different pellet sizes and barrel lengths. Steady-state rates of 2 s^{-1} have been obtained with 2.1- , 3.4- , and 4.0-mm-diameter pellets. The present apparatus operates at higher firing rates in short bursts; for example, a rate of 6 s^{-1} for 2 s with the larger pellets. These pellet parameters are in the range applicable for fueling large present-day fusion devices such as the Tokamak Fusion Test Reactor (TFTR). Experimental results are presented, including effects of propellant pressure and barrel length on gun performance.

33050 MARS: Mirror Advanced Reactor Study. Logan, B.G. (Lawrence Livermore National Laboratory, University of California, Livermore, California 94550). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **3**: No. 3, 1129-1133(May 1985). Contract W-7405-ENG-48.

A recently completed 2-year study of a commercial tandem mirror reactor design [Mirror Advanced Reactor Study (MARS)] is briefly reviewed. The end plugs are designed for trapped particle stability, stability against MHD ballooning modes, balanced geodesic curvature, and small radial electric fields in the central cell. New technologies such as lithium-lead blankets, 24T hybrid coils, gridless direct converters, and plasma halo vacuum pumps are highlighted.

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33051 **Measurement of the wall radiation in soft x-ray region in PDX (abstract).** Sesnic, S.; Tenney, F.H.; Bitter, M.; Hill, K.W.; von Goeler, S. (Princeton University, Plasma Physics Laboratory, Princeton, New Jersey 08544). *Review of Scientific Instruments;* **56**: No. 5, 847-847(May 1985).

A detector setup with three LN-cooled Si(Li) diodes is used to measure soft x-ray spectra (0.8—20 keV) emitted from the inside walls of the PDX vessel during the plasma discharge. The setup is part of a pulse-height-analysis system, which is used to measure the plasma and wall radiation simultaneously at five different radial positions. The wall and the plasma radiation are measured under different plasma conditions (e.g., OH and neutral beam heating). The wall radiation is very much increased during the neutral beam heating, with an enhancement factor of at least 10 over the OH wall radiation. Since we measure the plasma and the wall radiation at the same time, the measurements allow the conclusion that the wall radiation can be attributed essentially to fluorescence (line radiation, e.g., Ti-K/sub α/) and scattering (continuum part of the wall radiation spectrum). The fluorescence and the scattering are both caused by soft x-ray radiation flux coming from the plasma. There seems to be no need to invoke other, more exotic causes for the wall radiation, for example, charge particle bombardment of the wall.

33052 **Neutral beam injector oxygen impurity measurements and concentration reduction via gettering processes.** Kane, R.J.; Hsu, W.L.; Kerr, R.G.; Mills, B.E.; Poulsen, P.; Hibbs, S. (Lawrence Livermore National Laboratory, University of California, Livermore, California 94550). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **3**: No. 3, 1081-1084(May 1985). Contract W-7405-ENG-48.

We have measured the reduction of oxygen impurity levels by means of gettering within the arc chambers of the TMX-U neutral-beam injectors using the TMX-U neutral-beam test stand. Our analysis incorporated silicon surface-probe measurements and optical Doppler-shift measurements of the hydrogen alpha spectra of deuterium atoms with energies appropriate for D_2O parentage. Without gettering, the Auger electron spectroscopy analysis of an exposed silicon sample showed a large oxygen peak below the surface peak with a concentration equivalence of approximately 2% for an accelerated beam. After gettering, with either titanium or chromium getters, optical monochromator data indicated a reduction in the oxygen concentration of at least a factor of 10, whereas Auger spectroscopy data showed at least a factor of 8 reduction. Other metallic impurities remained below the level of detection even after gettering. Additional effects observed during this study include a change in the accelerated deuterium species concentrations, loss of gettering activity, loss of arc operation, and a change in arc performance due to arc chamber gas absorption during operation.

33053 **Status of TFTR with Ohmic heating and neutral beam injection.** Grove, D.J. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08544). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **3**: No. 3, 1145-1150(May 1985). Contract AC02-76CH03073.

The main body of the paper addresses the current status of the Tokamak Fusion Test Reactor (TFTR) as of December 1984, with emphasis on the vacuum and surface physics aspects of its operation. A brief review is given of the first paper on the vacuum aspects of controlled fusion research to be presented to a Symposium of the American Vacuum Society. This was given at the Fifth Symposium in October 1958 by the author of this paper. A comparison is made of the devices of that time with TFTR. The vacuum vessel diameter has gone from 2 in. to 7 ft., the plasma durations from 2 ms to many seconds, and the energy confinement time has increased by a factor of 1000 to 0.4 s. TFTR plasmas have reached densities of 4×10^{13} cm^{-3} with electron and ion temperatures of 3 keV. Very preliminary results, with the injection of only 2 MW of 50—70 keV neutral hydrogen into deuterium plasma, show the expected ion heating and increase in neutron flux. These experiments also show roughly a 30% reduction in the energy confinement time from that of plasmas with only Ohmic heating, as has been noted in other tokamaks. Attention is called to the continuing importance of impurity control in fusion devices.

33054 **Halo plasma heating by neutral beam injection in TMX-U.** Hsu, W.L.; Bauer, W.; Kerst, R.A.; Wilson, K.L.; Simonen, T.C.; Foote, J.H.; Pickles, W.L. (Sandia National Laboratories, Livermore, California 94550). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **3**: No. 3, 1175-1178(May 1985).

The electron temperature and density of the halo in TMX-U have been measured by Langmuir probes to study the heating of the halo plasma by neutral beam injection. This study is motivated by the recent interest in using a pair of halo recyclers to enhance the halo density and thereby increase halo shielding. In present TMX-U operation, without halo recyclers, a halo density of 2×10^{12} cm^{-3} with electron temperature of 20 eV has been measured during the heating phase with neutral beam injection only. A halo power balance model incorporating several heating mechanisms resulting from neutral beam injection is described. The model accurately predicts the measured temperatures. At the halo density range that one expects to achieve with halo recyclers, the model predicts the existing TMX-U neutral beam sources to heat the halo to at least 30 eV.

33055 **Development of rf plasma generators for neutral beams.** Vella, M.C.; Ehlers, K.W.; Kippenhan, D.; Pincosy, P.A.; Pyle, R.V.; DiVergilio, W.F.; Fosnight, V.V. (Lawrence Berkeley Laboratory, Berkeley, California 94720). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **3**: No. 3, 1218-1221(May 1985). Contract W-7405-ENG-36.

The development of low frequency (1—2 MHz) rf plasma generators for high power neutral beam applications is summarized. Immersed couplers from one to three turns were used. Acceptable plasma profiles, < or =15% max/min, were obtained in a variety of field-free, magnetic bucket and magnetic filter-bucket sources, with 10 x 10 or 10 x 40 cm extraction areas. Hydrogen beam properties were measured with a 7 x 10 cm accelerator operated at 80 kV. Atomic fraction and power efficiency were at least as high as with arc plasmas in similar chambers. The potential advantages of an rf plasma source are: ease of operation; reliability; and extended service lifetime.

33056 **Noncontact thermal gradient method for fabrication of uniform cryogenic inertial fusion target.** Kim, K.; Mok, L.; Erlenborn, M.J.; Bernat, T.P. (Fusion Technology Laboratory, University of Illinois, Urbana, Illinois 61801). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **3**: No. 3, 1196-1200(May 1985).

A new method for fabricating a uniform layer of fuel condensate inside a spherical-shell inertial confinement fusion target is described. In this method, target cooling is done in a vertically imposed temperature gradient whose magnitude is continuously controlled until the thermally induced effects precisely counterbalance the gravity effect. As a consequence, gravity-induced fuel sagging is completely eliminated resulting in the formation of a uniform fuel-condensate layer on the inner surface of the target. Since the present method is immune to the gravity effect, it is uniquely qualified for fabricating targets containing a thick fuel layer: an important capability no other existing method possesses. A brief description of the experimental methods and the preliminary results showing the promise of the new method are presented.

33057 **Thickness uniformity measurements of plastic-coated glass shells by image analysis of x-ray radiographs.** Alexander-True, S.M.; True, M.A. (KMS Fusion, Inc., Ann Arbor, Michigan 48106). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **3**: No. 3, 1258-1261(May 1985).

Digitized x-ray radiographs of plastic-coated glass shells were analyzed for thickness uniformity. The glass shells were 2 μ thick with a radius of 100 μ and the plastic coating was 20 μ thick. Nearly circular contours of image intensity for the inner edge of the glass shell and the outer edge of the plastic coating were constructed. The difference between the contour radii (the thickness of the glass and plastic) was interpolated on an evenly spaced angular grid along the circumference. The thickness was Fourier analyzed with respect to the angle variable. Low angular frequency perturbations which characterize large scale thickness nonuniformity were observed.

33058 **Effective hydrogen gas temperature in a cryopumped beam line vessel.** Kim, J.; Fasolo, J.A. (GA Technologies, Inc., San Diego, California 92138). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* 3: No. 3, 551-552(May 1985). Contract AT03-80SF11512.

Thermal accommodation of hydrogen gas molecules to cold surfaces modifies the effective gas temperature in cryogenically pumped vacuum vessels. In Doublet III neutral beam lines, gas pumping is achieved by liquid-helium-cooled panels which are surrounded by liquid-nitrogen-cooled thermal shields. By measuring the gas pressure during the injection of a known amount of gas while cooling the thermal shields by liquid nitrogen, we have determined the effective gas temperature according to $T/T_0 =$ (P/sub i//P/sub i/o)^2, where P/sub i/ is the pressure monitored by an ionization gauge and the subscript o refers the case of room temperature. The effective gas temperature was determined to be about 150 K when only the thermal shields were cooled down to the liquid nitrogen temperature. Implications of the reduced gas temperature on pressure measurement, pumping speed measurement, and neutral beam reionization loss calculation are discussed.

33059 **Experimental measurements of melting and vaporization due to simulated plasma disruptions.** Easoz, J.R.; Bajaj, R. (Westinghouse Advanced Energy Systems Division, Madison, Pennsylvania 15663). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* 3: No. 3, 1119-1124(May 1985). Contract AC02-83ER52094.

The first wall and limiter surfaces of magnetic confinement fusion devices will be subjected to intense pulsed thermal loads due to plasma disruptions which can result in vaporization and melting limiting the lifetime of these components. This paper presents experimental data on the vaporization and melting of AXF-5Q graphite, Type 316 stainless steel, OFHC copper and tantalum due to thermal loads varying up to 2400 J/cm^2 applied for times between 1 and 50 ms. The surface thermal loads were simulated with a 120-keV electron beam in the electron beam surface heating (ESURF) facility. The analysis procedure consisted of determining vaporization losses through weight-loss measurements and evaluation of the melt zone thickness through a metallographic sectioning procedure. Comparisons with some of the more recent theoretical predictions are made. The data trends (i.e., increasing melt and vaporization with energy density, existence of threshold energy densities, and melt thickness limits at high energy density due to increased vaporization) are generally found to agree with the analytical predictions. However, the magnitude of the melt zone thicknesses and vaporization losses show differences significant enough to warrant investigation of both modeling assumptions and the experimental techniques and conditions.

33060 **Plasma modeling of MFTF-B and the sensitivity to vacuum conditions.** Porter, G.D.; Rensink, M. (Lawrence Livermore National Laboratory, University of California, Livermore, California 94550). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* 3: No. 3, 1157-1160(May 1985). Contract W-7405-ENG-48.

The tandem mirror machine, MFTF-B, is scheduled to begin operation early in 1987. We have developed a time-dependent plasma-modeling code to examine the expected operating parameters. Using this code, we studied the effect of vacuum conditions on the plasma in each region of the machine. In particular, this study specified the vacuum requirements to which the machine is being designed. We will present the details of our study together with the current design of the vacuum system.

33061 **Nuclear microprobe and its applications to controlled fusion research.** Doyle, B.L. (Sandia National Laboratories, Ion—Solid Interactions Division 1111, Albuquerque, New Mexico 87185). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* 3: No. 3, 1374-1379(May 1985). Contract AC04-76DP00789.

A nuclear microprobe analysis system attached to Sandia's EN tandem Van de Graaff accelerator is described. A magnetic quadrupole doublet lens is used for the final focus to obtain beams of 2 μm diameter. Several illustrative applications of the microprobe involving its use in the 1D, 2D, and 3D profiling analysis of fusion reactor components are given.

33062 **Transparent electrode for optical switch.** Goldhar, J.; Henesian, M.A. (to Dept. of Energy). US Patent Application 6-662,641. 19 Oct 1984. 20p. Contract W-7405-ENG-48.

The invention relates generally to optical switches and techniques for applying a voltage to an electro-optical crystal, and more particularly, to transparent electodes for an optical switch. System architectures for very large inertial confinement fusion (ICF) lasers require active optical elements with apertures on the order of one meter. Large aperture optical switches are needed for isolation of stages, switch-out from regenerative amplifier cavities and protection from target retroreflections.

33063 **Electro-optic harmonic conversion to switch a laser beam out of a cavity.** Haas, R.A.; Henesian, M.A. (to Dept. of Energy). US Patent Application 6-662,642. 19 Oct 1984. 28p. Contract W-7405-ENG-48.

The present invention relates to switching laser beams out of laser cavities, and more particularly, it relates to the use of generating harmonics of the laser beam to accomplish the switching. When laser light is generatd in a laser cavity the problem arises of how to switch the laser light out of the cavity in order to make use of the resulting laser beam in a well known multitude of ways. These uses include range finding, communication, remote sensing, medical surgery, laser fusion applications and many more. The switch-out problem becomes more difficult as the size of the laser aperture grows such as in laser fusion applications. The final amplifier stages of the Nova and Novette lasers at Lawrence Livermore National Laboratory are 46 centimeters with the laser beam expanded to 74 centimeters thereafter. Larger aperture lasers are planned.

33064 **Limiter.** Cohen, S.A.; Hosea, J.C.; Timberlake, J.R. (to Dept. of Energy). US Patent Application 6-662,645. 19 Oct 1984. 13p. Contract AC02-76CH03073.

A limiter with a specially contoured front face is provided. The front face of the limiter (the plasma-side face) is flat with a central indentation. In addition, the limiter shape is cylindrically symmetric so that the limiter can be rotated for greater heat distribution. This limiter shape accommodates the various power scrape-off distances λ p, which depend on the parallel velocity, V/sub parallel/, of the impacting particles.

33065 **Cost assessment of a generic magnetic fusion reactor.** Sheffield, J.; Dory, R.A. (Oak Ridge National Laboratory, Martin Marietta Energy Systems, Inc., Oak Ridge, Tennessee). *Proceedings, Intersociety Energy Conversion Engineering Conference;* 3: 1567-1569(Aug 1984). (CONF-840804—).

From Intersociety energy conversion engineering conference; San Francisco, CA, USA (19 Aug 1984).

A generic magnetic fusion reactor model is used to determine the conditions under which electricity generation from fusion would be economically viable. The use of a generic model helps to circumvent problems associated with present perceptions of magnetic configurations. It helps also to decouple those limitations set by generic constraints such as nuclear cross sections from those set by the state of development today. The model shows that only moderate advances are required in reactor characteristics over current designs to make an economically attractive magnetic fusion reactor.

33066 **Inertial confinement fusion: Present status and future potential.** Hogan, W.J. (Lawrence Livermore National Laboratory). *Proceedings, Intersociety Energy Conversion Engineering Conference;* 3: 1560-1565(Aug 1984). (CONF-840804—).

From Intersociety energy conversion engineering conference; San Francisco, CA, USA (19 Aug 1984).

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Power from inertial confinement fusion holds much promise for society. This paper points out many of the benefits relative to combustion of hydrocarbon fuels and fission power. Potential problems are also identified and put in perspective. The progress toward achieving inertial fusion power is described and results of recent work at the Lawrence Livermore National Laboratory are presented. Key phenomenological uncertainties are described and experimental goals for the Nova laser system are given. Several ICF reactor designs are discussed.

33067 **Surface melting and evaporation during disruptions in magnetic fusion reactors.** Hassanein, A.M. (Argonne National Lab., IL (USA)); Kulcinski, G.L.; Wolfer, W.G. (Wisconsin Univ., Madison (USA). Dept. of Nuclear Engineering). *Nuclear Engineering and Design/Fusion;* 1: No. 3, 307-324(Jul 1984).

Disruptions in tokamaks lead to high energy deposition for short times on in-vessel components. Melting and evaporation may then occur. A comprehensive model to evaluate the extent and duration of melting, the amoung of evaporation, and the time for resolidification is presented. This model entails the solution of a heat conduction problem with two moving boundaries, the liquid surface and the melt-solid interface with a surface boundary condition determined by the dynamics of evaporation. Extensive numerical results are presented for in-vessel components made of stainless steel, molybdenum, or graphite. The effects of vapor shielding, pulse shape, and pulse duration are also investigated.

99 GENERAL AND MISCELLANEOUS

33068 **(BNL—35652) Re-analysis of Boston materials inventory.** Daum, M.L.; Lipfert, F.W. (Brookhaven National Lab., Upton, NY (USA)). Oct 1984. Contract AC02-76CH00016. 28p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85012993.

In 1978 the Electric Power Research Institute (EPRI) contracted with TRC Environmental Consultants, Inc., to develop an inventory of exposed man-made (structural) surfaces in Boston. Previous studies have used production statistics and population distribution patterns to estimate the areal distribution of exposed materials. The EPRI/TRC inventory was designed to determine the validity of this approach by directly estimating quantities of exposed materials in a typical northeastern city, the Boston SMSA. Among its findings in the EPRI report, TRC noted that most materials are not uniformly distributed even at a neighborhood scale. Purpose of this reanalysis was to determine if the distributions and/or the amount of exposed materials as inventoried in the Boston area are related to some land use, demographic, or economic factors.

33069 **(DOE/ER—0165/2) Nuclear engineering enrollment and degrees, 1984: data summary.** Sweeney, D.H.; Shirley, D.L. (Oak Ridge Associated Universities, Inc., TN (USA)). Mar 1985. Contract AC05-76OR00033. 68p. NTIS, PC A04/MF A01 - GPO; GPO Dep. File Number TI85013258.

The 1984 nuclear engineering survey included 71 academic institutions. Sixty-six responded that they have active programs. Enrollments at all degree levels decreased in 1984 from 1983. Undergraduates and master's candidate enrollments decreased by 3% each, and doctoral enrollments decreased by slightly less than 1%. Bachelor's degrees awarded in 1984 increased from 674 in 1983 to 728. Doctoral degrees awarded also increased over the past year from 124 to 132. Master's degrees awarded decreased from 325 to 316, 19% of the bachelor's went to work for nuclear utilities, while 18% elected to continue their studies. Continued study represented the largest placement category for master's (29%). Nuclear utilities (15%) and other industrial (14%) were reported as employing the most master's. Placement for the largest portion (20%) of Ph.D.s was unknown. Other industrial was the largest employer of Ph.D.s (19%); and US academic was the second largest employer of Ph.D.s (14%). The largest placement category reported for foreign national bachelor's and master's was continued study. Nineteen percent (23 out of 123) of the master's foreign nationals went to work in foreign countries. Foreign employment was also the largest placement category for Ph.D.s. Other statistical data breakdowns include women and minorities, and regional distribution.

33070 **(DOE/OR/21400—T101) Politics of schism: routinization and social control in the International Socialists/ Socialist Workers' Party.** Rayner, S. (Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 29p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85008358.

The received wisdom of social science holds that voluntary organizations founded on egalitarian principles, can only survive by undergoing transformation into hierarchical systems. The underlying logic of Weber, Michels and Toennies' descriptions is that social organizations sustain themselves over time by generating increasingly complex systems of rules that become sources of inequality. This article argues that routinization in voluntary groups does not consist of a gradual accumulation of rules that promote internal inequality. Instead, two analytically distinct steps are proposed: (1) construction of a distinctive organizational boundary, which is a necessary condition for (2) the ultimate imposition of a complex organizational hierarchy. The case used to illustrate this argument is drawn from the history of the British Trotskyist movement prior to 1978. The argument itself is framed within a formal model of the sociology of knowledge called grid/group analysis.

33071 **(DPST—85-1-3) Savannah River Laboratory monthly report.** (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Mar 1985. Contract AC09-76SR00001. 17p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85011047.

Reported are: seismic evaluation of L Reactor; target slug identification technique; management of control rods in Mark 22 operation; VENTSAR: a computer code to determine near-in dispersion for postulated SAR accidents; soil gas survey technique for locating organic contamination; prototype FB-Line multipurpose filter pans; evaluation of solvent extraction computer models; waste glass dissolution; analytical requirements for the Fuel Production Facility; solubility of deuterium in austenitic alloys; electrolytic reduction of nitrate and nitite salts; and radio communication for hazardous environments.

33072 **(GAO/RCED—85-25) Bureau of Reclamation could identify more unneeded land.** (General Accounting Office, Washington, DC (USA). Resources, Community and Economic Development Div.). 12 Apr 1985. 71p. General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877. File Number TI85901574.

A January 1983 Bureau of Reclamation report identified about 1.3 million acres of land as unneeded for project purposes. That report, however, did not include 472,600 acres which GAO subsequently identified as unneeded. This occurred primarily because Reclamation's annual property reviews did not include detailed reviews of specific parcels of land and it had not completed reviewing the need for all public domain land under its jurisdiction. Recognizing the need to improve its land management program, Reclamation has been implementing a land-use inventory and automated real property asset management system. This could help Reclamation develop a comprehensive and accurate inventory of land no longer needed for project purposes. Normally, proceeds from the sale of unneeded land are used to reduce the financial obligations of irrigation districts. In this respect, three irrigation districts at the Columbia Basin Project in Washington could receive reductions in their repayment obligations of about $39 million if 73,000 acres of unneeded land are sold. The land was purchased by the federal government in the early 1940's for other than water project purposes. GAO recommends that Reclamation consider whether the federal government's interests in this land outweigh the irrigation districts' asserted contractual, reliance, and equitable interests and refrain from selling additional settlement land until a determination is reached.

33073 **(IA—1404) Research laboratories annual report 1983.** (Israel Atomic Energy Commission, Tel Aviv). Jul 1984. 287p. NTIS (US Sales Only), PC A13/MF A01. File Number DE85780940.

Individual items in scope for the data base are processed separately.

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33074 **(AEC—652) Report on applications of nuclear science in New Zealand, 1981-1982.** (New Zealand Atomic Energy Committee, Lower Hutt). Oct 1982. 142p. NTIS (US Sales Only), PC A07/MF A01. File Number DE85701524.

This report describes the more important applications of nuclear science at various centres in New Zealand with emphasis on those involving research or new developments. The work within the Government departments, universities, hospitals and industry is summarized, and this is followed by the main reports.

33075 **(AECL—7683) Progress report: Physics Division, 1982 January 1 to March 1.** (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). May 1982. 137p. (PR-P—133). NTIS (US Sales Only), PC A07/MF A01. File Number DE85701525.

The work of the Physics Division at Chalk River Nuclear Laboratories during the quarter is presented. Areas of interest include nuclear physics, neutron sources, the development of a superconducting cyclotron, high current proton accelerators and electron accelerators, diffraction studies and other solid state physics work in organic and inorganic substances, and computer codes. The operation of the MP tandem accelerator and the computer facilities is reviewed.

33076 **(GSCAN-P—84-1A) Current research. Part A.** (Geological Survey of Canada, Ottawa, Ontario). 1984. 677p. NTIS (US Sales Only), PC A99/MF A01. File Number DE85780943.

Individual papers are indexed separately.

9902 Mathematics And Computers

REFER ALSO TO CITATION(S) 29804, 30920, 30925, 31430, 32539, 32878

33077 **(AD-A—150513/0/XAB) Parallel processing for computational continuum dynamics.** McGrath, J.F.; Hicks, D.L.; Liebrock, L.M. (KMS Fusion, Inc., Ann Arbor, MI (USA)). Jan 1985. 23p. (KMSF-U—1539). NTIS, PC A02/MF A01.

The numerical solution of many problems in continuum dynamics is seriously limited by the computation rates attainable on computers with serial architecture. Parallel-processing machines can achieve much higher rates. However, applying additional processors to a calculation is only part of the solution. In this report, parallel algorithms are developed for explicit and implicit, Lagrangian and Eulerian finite-difference schemes for computational continuum dynamics in one spatial dimension. First, the explicit conservation equations in the Lagrangian reference frame are readily reformulated for concurrent processing. Second, and implicit solution is derived for these equations. This is important because it yields unconditional stability. The parallelism is achieved via a block implicit numerical scheme. Third, a rezoning algorithm is employed with each Lagrangian integration step to transform the mesh back to the Eulerian reference frame. Along the algorithmic development path, a zone-by-zone parallelization gives way to a block-by-block technique both of which are self-scheduling. Then the latter is compared to an approach that keeps the parallel processes alive for many time steps. At each step of this research exploiting the architectural advantages of the HEP H1000 (Heterogeneous Element Processor) computer.

33078 **(AD-A—151376/1/XAB) Supercomputers and symbolic computation. Technical report for period ending 4 June 1984.** Arnon, D.S. (Purdue Univ., Lafayette, IN (USA). Dept. of Computer Science). 31 Dec 1984. 30p. NTIS, PC A03/MF A01.

This report is the record of a two-day workshop held at Purdue University on high-performance symbolic computation. The title reflects the interests of the participants, many of whom are practitioners of symbolic computing on supercomputer-class machines. The goal of the workshop was to assess the current state of affairs, and identify key issues requiring attention. The report is primarily a compendium of the positions taken, recommendations made, and questions raised by the participants.

33079 **(AD-A—151504/8/XAB) BLAS (Basic Linear Algebra Subroutines), linear algebra modules, and supercomputers. Technical report for period ending 15 December 1984.** Rice, J.R. (Purdue Univ., Lafayette, IN (USA). Dept. of Computer Science). 31 Dec 1984. 17p. NTIS, PC A02/MF A01.

On October 29 and 30, 1984 about 20 people met at Purdue University to consider extensions to the Basic Linear Algebra Subroutines (BLAS) and linear algebra software modules in general. The need for these extensions and new sets of modules is largely due to the advent of new supercomputer architectures which make it difficult for ordinary coding techniques to achieve even a significant fraction of the potential computing power. The workshop format was one of informal presentations with ample discussions followed by sessions of general discussions of the issues raised. This report is a summary of the presentations, the issues raised, the conclusions reached and the open issue discussions. Each participant had an opportunity to comment on this report, but it also clearly reflects the author's filtering of the extensive discussions. Section 2 describes seven proposals for linear algebra software modules and Section 3 describes four presentations on the use of such modules. Discussion summaries are given next; Section 4 for those where near concensus was reached and Section 5 where the issues were left open.

33080 **(AD-A—151970/1/XAB) Complexity of dense linear system solution on a multiprocessor ring. Research report.** Ipsen, I.C.F.; Saad, Y.; Schultz, M.H. (Yale Univ., New Haven, CT (USA). Dept. of Computer Science). Jan 1985. 29p. (YALEU/DCS/RR—349). NTIS, PC A03/MF A01.

Different algorithms, based on Gaussian elimination, for the solution of dense linear systems of equations, are discussed for a multiprocessor ring. The number of processors is assumed not to exceed the problem size. A fairly general model for data transfer is proposed and the algorithms are analyzed with respect to their requirements of arithmetic as well as communication times. This paper lays no claims to being either exhaustive or complete. Its objective is to compare a variety of algorithms, which are fairly reasonable to program and to analyze, for the solution of a single problem on a certain class of parallel architectures, thereby leading to a more realistic approach to future algorithm development on multiprocessor machines.

33081 **(AD-A—152095/6/XAB) Optimal parallel algorithms for graph connectivity. Technical report.** Reif, J.H. (Harvard Univ., Cambridge, MA (USA). Aiken Computation Lab.). 1984. 25p. (TR—08-84). NTIS, PC A02/MF A01.

A new randomized parallel RAM algorithm is given for finding a spanning forest of an undirected graph in logarithmic time. These time bounds hold with arbitrary high probability for any input graph (i.e., assume random input is not assumed; these bounds hold for the worst case input graph). This result assumes a parallel RAM model which allows both concurrent writes and concurrent reads. Furthermore, it is shown that if the graph is not very sparse (i.e., if the number of edges is at least a logarithmic squared factor more than the number of vertices) then a linear processor time product (even for logarithmic time bounds) can be achieved for finding a spanning tree--which is optimal for the parallel RAM model. Furthermore, a linear-processor, time product can be achieved for even sparser graphs with only slight time increase.

33082 **(CONF-830116—4) Accelerating nonsymmetrizable iterative methods.** Young, D.M.; Jea, K.C.; Kincaid, D.R. (Texas Univ., Austin (USA). Center for Numerical Analysis). Mar 1983. Contract AS05-81ER10954. 22p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85012471.

From Conference on elliptic problem solvers; Monterey, CA, USA (10 Jan 1983).

The object of this paper is to describe some recent work which has been done at The University of Texas at Austin and elsewhere on the development of procedures for accelerating nonsymmetrizable iterative methods. Approaches which we discuss include the use of the GCW method of Concus and Golub [1976] and of Widlund [1978], the use of the normal equations and related equations, Chebyshev acceleration, and some generalized CG acceleration procedures. Normally, the generalized CG acceleration procedures, in their idealized form, are too expensive in terms of computer time and storage for practical use. In the symmetrizable case the formulas simplify since many of the terms vanish. In some nonsymmetrizable cases, it is possible to achieve similar simplifications. We describe work on such simplifications done by Jea [1982] and Jea and Young [1983] as well as work of Faber and Manteuffel [1983]. We also show that the simplifications of Jea and Young [1983] can be used to derive three alternative forms of the Lanczos method (see Lanczos [1950, 1952]). A theoretical basis is given for choosing one of the forms in preference to the other two more frequently used forms.

33083 **(CONF-830116—5) ITPACK project: past, present, and future.** Kincaid, D.R.; Young, D.M. Jr. . (Texas Univ., Austin (USA). Center for Numerical Analysis). Mar 1983. Contract AS05-81ER10954. 12p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85012470.

From Conference on elliptic problem solvers; Monterey, CA, USA (10 Jan 1983).

The ITPACK project involves the development of research-oriented mathematical software, based on iterative algorithms, for solving large systems of linear algebraic equations with sparse coefficient matrices. The emphasis is on linear systems arising in the solution of partial differential equations by discretizations such as finite difference or finite element methods. Among other things this project has resulted in the development of a package of subroutines known as ITPACK which is available to the scientific community. Important features of the ITPACK routines include the adaptive determination of the iteration parameters and realistic procedures for terminating the iterative processes. An important application of ITPACK is for use as solution modules in the ELLPACK package of computer routines for solving a class of partial differential equations. We review the objectives of the ITPACK project, summarize the progress made to date and outline plans for future work. A summary is given of work on both software and research that has contributed to the present mathematical software package. The 2C version of ITPACK for scalar computers and a version for use on high performance vector computers are discussed. An overview is given of the developmental work on other software involving more general preconditioners and additional nonsymmetric procedures.

33084 **(CONF-8505131—2) Search of the VAXintosh customizing VMS V4.0 for DCL windows.** Downward, J.G. (KMS Fusion, Inc., Ann Arbor, MI (USA)). 1985. Contract AC08-82DP40152. 14p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85011306.

From Spring DECUS symposium; New Orleans, LA, USA (27 May 1985).

This paper will describe methods of implementing such windows for: (1) DCL and MAIL; (2) Command Procedures; and (3) the VMS V4.0 editors EDT, LSE and TPU. While VMS and a number of utilities have the SPAWN command available to the user, the window interface to be described has been found in practice to be simpler to use because: (1) windows are consistently invoked with a single key command; and (2) confusion is minimized because one always knows if one is in a window.

33085 **(DESY—84-118) Unfolding methods in high-energy physics experiments.** Blobel, V. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Dec 1984. 40p. (CONF-8409223—1). NTIS (US Sales Only), PC A03/MF A01. File Number DE85751638.

From CERN school of computing '84; Algua Blava, Spain (9 Sep 1984).

Distributions measured in high-energy physics experiments are often distorted or transformed by limited acceptance and finite resolution of the detectors. The unfolding of measured distributions is an important, but due to inherent instabilities a very difficult problem. Methods for unfolding, applicable for the analysis of high-energy physics experiments, and their properties are discussed. An introduction is given to the method of regularization.

33086 **(DOE/ER/10718—5) Toolpack. Final report, August 1, 1980-July 31, 1984.** Osterweil, L.J.; Fosdick, L.D. (Colorado Univ., Boulder (USA)). May 1985. Contract AC02-80ER10718. 23p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85013135.

The Toolpack project has produced a large configuration of tightly integrated tools comprising a numerical software development environment. As its participation in the Toolpack collaborative project, the University of Colorado created some major tool capabilities, devised and implemented Odin - an innovative tool integration system, and served technical coordinator during the early phases of the project. The combination of research, development and definitive evaluation which characterized our participation in the Toolpack project has been a uniquely challenging and stimulating opportunity to advance the state-of-the-art and the state of practice in the area of software tools and environments. Knowledge about tool integration has been significantly advanced through our development of Odin, and the widespread use of effective tools by an important software community will also be significantly advanced by our development of the Toolpack/IST prototype which has now given way to the distributed Toolpack/1 system.

33087 **(DOE/ER/10954—2) Research program in iterative solution and finite element analysis in computational mechanics. Annual progress report, 1983.** Carey, G.F.; Young, D.M. (Texas Univ., Austin (USA)). 1983. Contract AS05-81ER10954. 16p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85011900.

The second year of research concerning the theory and use of iterative methods in finite element approximation of boundary-value problems is covered. Significant progress has been made, especially in the development of a new technique, termed the local elliptic projection procedure, for use in adaptive finite element mesh refinement and iterative solution; analysis of errors for domain truncation to evaluate far field boundary conditions on finite domain approximations to a fully infinite domain; analysis of certain nonlinear literative methods for penalty finite element approximation of Navier-Stokes problems; development of a local element-oriented (block) iteration scheme and an algorithm for vector processors; the vectorization of the ITPACK software package; other work on vectorization; and the iterative solution of nonsymmetric linear systems.

33088 **(DOE/ER/13122—T1) Scientific workstation research. Second annual report, August 1984-July 1985.** Foley, J.D. (George Washington Univ., Washington, DC (USA). Dept. of Electrical Engineering and Computer Science). May 1985. Contract AS05-83ER13122. 6p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85013385.

During the past year we have continued to develop key concepts needed in graphics programming languages. The overall language structure consists of geometric modeling, viewing, interaction management, and display management subsystems. Within each area, we have been developing descriptions of the semantic capabilities required. Several important themes run through these capabilities. The themes are important because they will form the basis for constructs in the programming language. One of the themes is that of dynamic links. Links maintain dependencies between data variables (which might include graphic/geometric objects). Thus when variable A changes, so too do the other variables which have functional dependencies on A. Another theme is that of coordinate system. It seems natural that a graphics language deal with coordinate systems, and declare an object's coordinate system as one of its attributes. We then use another theme, that of a transformer, to relate one coordinate system to another. Transformers are useful in input (to relate the coordinate system of a mouse or tablet to the world coordinate system), and in viewing (to relate world coordinates to the screen). Another concept used is that of additional dimensions as a means of specifying attributes. The intensity of a point, for example, is just another (non-geometrical) coordinate of the point. By treating attributes in this way, the attribute values can be operated on by transformers: a separate language construct is not needed.

33089 **(DOE/TIC—3386-Suppl.1) Computer codes: a bibliography. Supplement 1.** Thoeming, G.H. (ed.). (USDOE Office of Scientific and Technical Information, Oak Ridge, TN). Jun 1985. 987p. NTIS $36.75/MF A01; GPO Dep. File Number DE85008721.

Included are 3964 citations to literature on computer codes contained in the DOE Energy Data Base for the period March 1981 through January 1985. The citations represent all Energy Data Base subject categories and include reports, journal articles, books, conference papers, and monographs. Corporate, Personal Author, Subject, and Report Number Indexes are provided.

33090 **(IFT-P—01/83) Zeroes of infinite series.** Aguilera-Navarro, V.C.; Aguilera-Navarro, M.C.K. (Instituto de Fisica Teorica, Sao Paulo (Brazil)). 1983. 11p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85701116.

A recursive method to obtain a zero of an infinite series is described.

33091 **(IFVE-OEA—83-162) Dialog guide programs for operators of scanning-measuring projectors in the COSDES system. Part 2. Guide program realization.** Ammosov, V.V.; Ivanov, Yu.N.; Ivanova, N.S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1983. 19p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85701286.

The guide programs realized in the COSDES system adapted to the DEC-10 computer exercising the control of the scanning-measuring projector operator work in the dialog regime are described. Algorithms of the programs, their peculiarities according to requirements of physical experiments are considered. Characteristics of the programs and the results of their use are given. The guide programs are used for data processing in experiments with the Mirabel and BEBC bubble chambers and with the 15-feet Fermilab chamber. The programs are written in the assembler MACRO-1O and FORTRAN languages.

33092 **(JAERI-M—84-033) DDXPLOT: a program to plot the energy angle double-differential cross sections.** Iguchi, Tetsuo; Yamano, Naoki. (Japan Atomic Energy Research Inst., Tokyo). Feb 1984. 39p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. File Number DE85701123.

A program "DDXPLOT" has been developed to plot the energy-angle double differential cross sections (DDX) calculated from the current evaluated nuclear data library with the experimental data. The calculated DDX data of each reaction type are summed up and smoothed out according to the experimental conditions. Furthermore, the DDX data from various evaluated libraries can be compared with one another, by specifying the identification names in the data pool. This report is the manual of DDXPLOT.

33093 **(JINR—10-83-852) AUTOP program package for spectrometric data on-line processing using small computers.** Churakov, A.K.; Byalko, A.A.; Volkov, N.G.; Ferentsei, J.; Fominykh, M.I.; Tsupko-Sitnikov, V.M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1983. 15p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85701124.

Submitted to the journal Prikladnaya Yadernaya Spektroskopiya.

The AUTOP service prgram package intended for the solution of various problems connected with spectrometric data processing using small computers is described. All programs are written in the FORTRAN-4 and adapted for the SM-3, SM-4 and ES-1010 computers. The AUTOP package comprises the FITDEV subroutine for approximation of experimental data by arbitrary analytical functions, the RETIX program for solution of the Fredholm first kind equation for the problems of distorted data reconstruction, the AUTOP program for on-line spectra processing realizing automatic peak identification, multiplet separation and peak parameter determination by assymetric gaussion fit, the PUCH program for separate spectrum part processing, the MESS program for processing the nuclear gamma resonance (NGR) spectra using the index algorithm for the approximating function representation, the SPLINE program for analytical curve plotting by the spline-MNK method, the CMGR program for output of the spectrum curve, the NUGRAF program for plotting the curve of spectrum part decompositiogn, the MESGRF program for plotting NGR spectra decomposition curves. The AUTOP main set can be used with the RAFOS or RT 11 V03 (02) operational systems for the SM-3 computer with immediate-access memory volume not less than 32 K. The module principle on which the AUTOP package is based permits to use it widely in various fields dealing with processing the data both spectrometric and not related to spectrometry (analysis of volt-ampere characteristics, apparatus noises, optimal experiment planning).

33094 **(KFK—3833) MODEASY - a program-system for modification and management of stored functions of one independent variable.** Heger, R.; Kuefner, K. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Schneller Brueter). Dec 1984. 148p. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number DE85751654.

FORTRAN-77.

The FORTRAN-77 program MODEASY is used for management and modification of datasets that contain (normally many) functions of one independent variable. Those functions are stored as 3 records each, consisting of an identification part, abscissa and ordinates; e.g. as values at discrete points. As options are available so far: list, copy, delete, create, filtering, integration, Fourier-analysis, modification and renaming of curves as well as calculation of sum, deviation, linear combination and tabulation of several curves. Beside this there are some utility and special options available. Because of the strictly modular structure of the program it should be easy to add new options or to support another storage format of the curves.

33095 **(KFK—3855) MUSTAFA and MUSTAMO, computer programs for analysis of fault trees with multistate-components.** Wickenhaeuser, A. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorentwicklung; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Schneller Brueter). Feb 1985. 74p. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE85751645.

The two codes MUSTAFA and MUSTAMO are result and application of the methods for fault tree analysis newly developed by Caldarola during the last years. The two programmes overcome the basic difficulties of the analytical methods: the limited flexibility and difficulties with the handling of large interconnected systems. Basis of the new approach is the Boolean Algebra with restricted variables which allows for to handle components or supercomponents with more than two states. The programme MUSTAFA provides the following capabilities: handling of components with more than two states, modelling of statistical dependencies in various ways, identification of an incoherent Boolean function and its reduction to a smaller basis, extension of a Boolean function for exact calculation of probabilities and calculation of transfer rates between different states of the system. In addition to these capabilities MUSTAMO is able to subdivide large and strongly interconnected fault trees into smaller subsystems and either by horizontal subdivision into modules and supercomponents or by vertical subdivision via the splitting procedure. The report consists of the following parts: explanation of the methods used, description of the application using different options within the code structure and sample cases.

33096 **(LA-UR—84-3370) Information-theoretic model of the programming process.** Coulter, N.S. (Los Alamos National Lab., NM (USA); Florida Atlantic Univ., Boca Raton (USA)). 1985. Contract W-7405-ENG-36. 22p. (CONF-850709—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE85002419.

From National computer conference; Chicago, IL, USA (22 Jul 1985).

Aspects of computer programming activities have been modeled by numerous researchers. The model presented here is based on an information-theoretic description that provides a unified formalization of the programming process from specification through implementation. The concept of an algorithm's problem space is developed, and the complexity of an algorithm is defined in terms of its associated variables and their values. An algorithm's complexity is derived from the declaration section of the resulting program. Because a program's declarations are derivable before the program body is implemented, a program's complexity can be estimated before it is completed. This model provides insight into the comparative complexities of problem spaces and suggests ways of subdividing those problem spaces and their associated programs.

33097 **(LA-UR—85-828) New probabilistic modeling and simulation methods for complex time-dependent systems.** Bartholomew, R.J. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 13p. (CONF-850723—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85009575.

From 7. international system safety conference; San Jose, CA, USA (25 Jul 1985).

This paper is a tutorial that presents a new method of modeling the probabilistic description of failure mechanisms in complex, time-dependent systems. The method of modeling employs a state vector differential equation representation of cumulative failure probabilities derived from Markov models associated with certain generic fault trees, and the method automatically includes common cause/common mode statistical dependencies, as well as time-related dependencies not considered in the literature previously. Simulations of these models employ a population dynamics representation of a probability space involving probability particle transitions among the Markov disjoint states. The particle transitions are governed by a random, Monte Carlo selection process.

33098 **(LA-UR—85-1817) Using an LSI-11/23 and RT-11 to digitize analog tapes.** Stewart, J.N. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 7p. (CONF-8505131—4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85012736.

From Spring DECUS symposium; New Orleans, LA, USA (27 May 1985).

The author describes in this paper the design and implementation of a system on an LSI-11/23 under RT-11 that digitizes 14-channel analog tapes at given intervals and writes the digitized data to a magnetic tape. The analog tapes contain 13 channels of data and one channel of IRIG-B time code. A given interval is selected by entering a time and an interval. The IRIG-B time code is read from the analog tapes and used to start the digitizing. A programmable clock board is used to control the digitizer and to count the interval length. In order to achieve the through-put rates needed, the author wrote the code in MACRO and addressed the magnetic tape controller directly instead of using programmed requests.

33099 **(PNL-SA—13023) Managing data analysis through save-states.** Cowley, P.J.; Whiting, M.A. (Pacific Northwest Labs., Richland, WA (USA)). Apr 1985. Contract AC06-76RL01830. 8p. (CONF-8503116—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE85012456.

From 17. symposium on the interface of computer science and statistics; Lexington, KY, USA (17 Mar 1985).

Data analysis management is a methodology intended to increase the productivity of the data analyst. A primary entity for data analysis management is the "save-state", a collection of metadata and data that captures a state of the analysis. The analyst may create a save-state to designate a milestone of the analysis. The save-state may be used later to return to that milestone by restoring the conditions of the analysis that existed at the time the save-state was created. Scientists at Pacific Northwest Laboratory (PNL) have developed a prototype data analysis management system. In that system, a save-state includes pointers to the data sets and command procedures active at the time the save-state was created, active plot descriptions and other graphics parameters, and comments supplied by the analyst. Associated with each save-state is a record of the sequence of commands or operations used to accomplish the transition from the previous (parent) save-state. Metadata also describes the overall relationships between the save-states that have been created during the analysis.

33100 **(SAND—85-0391C) Simulation of lattice damage due to dynamic loading.** Taylor, P.A.; Dodson, B.W. (Sandia National Labs., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 10p. (CONF-850736—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE85008468.

From American Physical Society topical conference on shock waves in condensed matter; Spokane, WA, USA (22 Jul 1985).

By means of a dynamic simulation technique developed by the authors and based upon the Monte Carlo method, we investigate the response of two-dimensional Lennard-Jones lattice systems to dynamic uniaxial strain paths that are either fast or slow with respect to a lattice equilibration time. The simulation of lattice response to various compression-release cycles indicates a dependence of the degree of sustained lattice damage (i.e., dislocations and defects) on the rate and maximum amplitude of applied strain. Specifically, greater lattice damage is predicted whenever the lattice is subjected to a fast-loading process and/or higher maximum strain amplitude as compared to that induced by a slow-loading process and/or lower maximum strain amplitude.

33101 **(SAND—85-0725C) Control of step size and order in extrapolation codes.** Shampine, L.F. (Sandia National Labs., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 29p. (CONF-850752—1). NTIS, PC A03/MF A01; GPO Dep. File Number DE85010122.

From South African symposium on numerical math; Durban, South Africa (8 Jul 1985).

Extrapolation of the semi-implicit midpoint rule is an effective way to solve stiff initial value problems for a system of ordinary differential equations. The theory of the control of step size and order is advanced by investigating questions not taken up before, providing additional justification for some algorithms, and providing support for procedures not properly justified by the information theory approach of Deuflhard. An experimental code SIMP implementing the algorithms proposed is shown to be as good as, and in some respects much better than, the research code METAN1 of Bader and Deuflhard. 18 refs.

33102 **(SAND—85-0856) Experiments and improvements of the ordinary differential equation solvers DEPAC on the CRAY computer.** Watts, H.A. (Sandia National Labs., Albuquerque, NM (USA)). May 1985. Contract AC04-76DP00789. 32p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85013260.

We have looked at timing results when solving large systems of differential equations using DEPAC on the CRAY computer. By reprogramming some critical (previously nonvectorized) loops, using loop unrolling where appropriate, and using the CRAY $SCILIB routines, significant speedup factors have been achieved. For example, when overhead is dominant (i.e., the derivative evaluation cost per component is minimal), we have observed cost reductions by factors of 2 to 7 when compared to the unmodified codes. We have also incorporated three additional user options which enable faster execution in appropriate circumstances. The modified DEPAC will replace the earlier package as part of the SLATEC library for use on the CRAY. The computational results produced are identical to those obtained by the earlier codes.

33103 **(SAND—85-1110C) Graph-theoretical exorcism.** Simmons, G.J. (Sandia National Labs., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 11p. (CONF-850283—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE85011916.

From 16. Southeastern international conference on combinatorics, graph theory, and computing; Boca Raton, FL, USA (11 Feb 1985).

Given a graph G and an ordering phi of the vertices, V(G), we define a parsimonious proper coloring (PPC) of V(G) under phi to be a proper coloring of V(G) in the order phi, where a new color is introduced only when a vertex cannot be properly colored in its order with any of the colors already used.

33104 (SOL—85-5) Practical approach to Karmarkar's algorithm. Lustig, I.J. (Stanford Univ., CA (USA). Systems Optimization Lab.). Jun 1985. Contract AT03-76ER72018. 22p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85013188.

A practical approach to implementing Karmarkar's algorithm is discussed. A variant of the algorithm is proposed which still has polynomial complexity and which eliminates the need for Karmarkar's canonical form. This method allows upper and lower bounds to be used and does not require knowledge of the objective value. Some heuristics are given which alleviate certain computational difficulties that arise when a practical implementation of the algorithm is attemped. A FORTRAN program is described that allows one to study its convergence properties.

33105 (UCID—20422) Flat is not necessarily good. Balaban, D.J.; Nelson, D.O. (Lawrence Livermore National Lab., CA (USA)). 17 Apr 1985. Contract W-7405-ENG-48. 8p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85012819.

The disciplines of software engineering and expert system building seem very different from each other. The software engineer describes a system in terms of its interactions with a simplified version of the world around it. The expert system builder, on the other hand, describes a system in terms of knowledge acquired from an available expert and strategies for exploiting that knowledge. In fact, this perceived difference is due in large part to a difference in the complexity of the world being modeled. In this paper we explore the relationship between these two disciplines and describe means by which new AI techniques can be directly used to extend software engineering methodologies without also importing deficiencies inherent in rule-based expert systems.

33106 (UCRL—92480) Some ideas for decomposing the domain of elliptic partial differential equations in the Schwarz process. Rodrigue, G. (Lawrence Livermore National Lab., CA (USA)). Mar 1985. Contract W-7405-ENG-48. 12p. (CONF-8503129—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE85011844.

From Symposium on algorithms, architectures and the future of scientific computation; Austin, TX, USA (18 Mar 1985).

Simulations have shown that one of the major breakdowns in the efficiency of a multiprocessing computing system is overcommunication between the computer modules. Experiments on the CRAY XMP/2 seem to corroborate these predictions. Consequently, in designing numerical methods for multiprocessors, algorithms are sought that can be partitioned so that communication between the algorithmic tasks is minimized. In scientific calculations, this communication amounts to the passing of numerical data that mathematically couple the individual scientific processes. Thus, the goal in multiprocessing scientific calculations is to define individual scientific processes that are weakly coupled to one another. Many partial differential equations have an inherent potential for multiprocessing in the domain of dependence of the independent variables. To illustrate, we consider the numerical solution of the partial differential equation: partial u/partial t = F(x, u, t, D/sub x/u, D/sub x/^{2}u, ...).

33107 (UCRL—92624) Parallel processing on the Livermore VAX 11/780-4 parallel processor system with compatibility to Cray Research, Inc. (CRI) multitasking. Version 1. Werner, N.E.; Van Matre, S.W. (Lawrence Livermore National Lab., CA (USA)). May 1985. Contract W-7405-ENG-48. 48p. (CONF-8505131—3). NTIS, PC A03/MF A01; GPO Dep. File Number DE85011856.

From Spring DECUS symposium; New Orleans, LA, USA (27 May 1985).

This manual describes the CRI Subroutine Library and Utility Package. The CRI library provides Cray multitasking functionality on the four-processor shared memory VAX 11/780-4. Additional functionality has been added for more flexibility. A discussion of the library, utilities, error messages, and example programs is provided.

33108 (UIUCDCS-R—85-1205) Implementing linear multistep formulas for solving DAES. Gupta, G.K.; Gear, C.W.; Leimkuhler, B. (Illinois Univ., Urbana (USA). Dept. of Computer Science). Apr 1985. Contract AC02-76ER02383. 36p. (UILU-ENG—85-1709; COO—2383-0107). NTIS, PC A03/MF A01; GPO Dep. File Number DE85012400.

The organization of an automatic code for differential-algebraic equations is discussed. The proposed code can handle a large class of problems of index no greater than two. 9 refs.

33109 Numerical generation of boundary-fitted curvilinear coordinate systems for arbitrarily curved surfaces. Takagi, T.; Miki, K.; Chen, B.C.J.; Sha, W.T. (Energy Research Laboratory, Hitachi, Ltd., 1168 Moriyama-cho, Hitachi-shi, Ibaraki-ken, 316 Japan). *Journal of Computational Physics;* **58**: No. 1, 67-79(Mar 1985).

A new method is presented for numerically generating boundary-fitted coordinate systems for arbitrarily curved surfaces. The three-dimensional surface has been expressed by functions of two parameters using the geometrical modeling techniques in computer graphics. This leads to new quasi-one- and two-dimensional elliptic partial differential equations for coordinate transformation. Since the equations involve the derivatives of the surface expressions, the grids geneated by the equations distribute on the surface depending on its slope and curvature. A computer program GRID-CS based on the method was developed and applied to a surface of the second order, a torus and a surface of a primary containment vessel for a nuclear reactor. These applications confirm that GRID-CS is a convenient and efficient tool for grid generation on arbitrarily curved surfaces.

9903 Information Handling

REFER ALSO TO CITATION(S) 30815

33110 (DOE/ER/10977—T7) Logical and physical modeling and design of scientific and statistical databases for energy research. Final technical report, July 1, 1981-May 31, 1984. Su, S.Y.W.; Navathe, S.B.; Batory, D.S. (Florida Univ., Gainesville (USA). Database Systems Research and Development Center). 1984. Contract AS05-81ER10977. 42p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85006081.

Research is summarized in these areas: semantic modeling and language design; complex data types; database mapping and integration; physical design; and parallel algorithms and database machines. 158 refs.

33111 (DOE/MI/01015—T1) User's guide for the Office of Minority Economic Impact National Information Clearinghouse System. (Ronson Management Corp., Alexandria, VA (USA)). 15 Jun 1982. Contract AC01-81MI01015. 71p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85012620.

The Office of Minority Economic Impact National Information Clearinghouse System (OMEI/NICS) is based on three other comprehensive and well established systems. They are the Technical Information Center's Descriptive Cataloging On-Line (DECOL), a bibliographic System in operation at Oak Ridge National Laboratory called RECON, and a Document Distribution System (DDS-2) operated at the DOE's Germantown Facility. All of these systems have extensive documentation. This document is designed to be an adjunct to that material. It provides an overview of each capability, annotates key sections of the systems documentation and concludes with a summary containing an outline of the steps necessary to accomplish the mainline functions of the OMEI application.

33112 (FRNC-TH—1551) Design and creation of a direct access nuclear data file. Charpentier, P. (Paris-11 Univ., 91 - Orsay (France)). Jun 1981. 198p. (In French). NTIS (US Sales Only), PC A09/MF A01. File Number DE85751298.

General considerations on the structure of instructions and files are reviewed. Design, organization and mode of use of the different files: instruction file, index files, inverted files, automatic analysis and inquiry programs are examined.

CORPORATE AUTHOR INDEX

In the Corporate Author Index, report literature is indexed using the name of the organization or institution responsible for issuing the report. Headings are provided for all report literature and for published literature for which a corporate approach is especially desirable, e.g., symposium and conference proceedings.

Each entry under a corporate heading gives the document title and the volume and abstract numbers. The document type, e.g., R for Report; country of publication, e.g., US; and language of the document, e.g., In German, are given in parentheses at the end of the entry. If no language statement appears, the language is English. Tables of document types and country of publication codes appear after the indexes.

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  Qualifier
    Title, (supplementary information), citation number, (R;US)

The notations in the final parentheses indicate the type of document, e.g., R for Report; the country of publication, e.g., US; and the language if other than English, e.g., In German. Tables of document types and country of publication codes appear after the indexes.

The title may be supplemented with additional words, or a phrase, if it appears additional information would be helpful. In cases for which the title contains little or no information related to the subject entry, it may be replaced entirely by the supplementary information. A qualifier is not always required, and in such cases the title will follow the unqualified subject descriptor.

The descriptors selected for use as subject terms are generally the names of specific materials, things, or processes. To the extent possible, a qualifier is selected to describe the properties of, or processes applied to, the subject term.

Index entries are selected to indicate the important ideas and concepts presented in a document, rather than words that may appear in the text. Within the available thesaurus terms, the most probable or logical place to look for typical information is selected. "See references" are included to guide users from synonymous terms or phrases to the descriptor selected as a subject heading for the concept (e.g., Pipeline Quality Gas, see HIGH BTU GAS). "See also references" are used to indicate where to find references to subject concepts that are narrower, broader, or related to a particular subject heading. To complete an exhaustive search of a given subject, all such headings should be reviewed. Copies of DOE/TIC-7000, the Subject Thesaurus, are available from the National Technical Information Service (NTIS), U.S. Department of Commerce, Springfield, VA 22161.

A

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	Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.	
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AC11-76PN00014	**Bettis Atomic Power Lab., West Mifflin, PA (USA)**	
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AC11-76PN00292	**Duquesne Light Co., Pittsburgh, PA (USA)**	
	10:30828	DOE/PN/00292—T5
AC12-76SN00052	**General Electric Co., Schenectady, NY (USA)**	
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AC15-76CL98004	**Burns and Roe, Inc., Oradell, NJ (USA). Breeder Reactor Div.**	
	10:30742	DOE/CL/98004—33
AC15-83CL01819	**Electric Power Research Inst., Palo Alto, CA (USA)**	
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AC20-83LC11003	**Arizona State Univ., Tempe (USA). Coll. of Engineering**	
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AC21-83MC20182	**Brigham Young Univ., Provo, UT (USA). Dept. of Chemical Engineering**	
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AC21-83MC20184	**Texas A and I Univ., Kingsville (USA). Dept. of Chemical and Natural Gas**	
	10:29695	DOE/MC/20184—1829
AC21-83MC20334	**Massachusetts Inst. of Tech., Cambridge (USA)**	
	10:31773	DOE/MC/20334—T19
AC21-83MC20342	**Institute of Gas Technology, Chicago, IL (USA)**	
	10:29805	DOE/MC/20342—1838
AC21-83MC20468	**TRW, Inc., Redondo Beach, CA (USA). Applied Technology Div.**	
	10:32034	TRW-SN—39146
AC21-84MC21233	**Westinghouse Electric Corp., Concordville, PA (USA). Combustion Turbine Systems Div.**	
	10:29720	DOE/MC/21233—T1
AC21-84MC21377	**Scientific Design Co., Inc., New York (USA)**	
	10:29620	DOE/MC/21377—T1
AC21-84MC21382	**Mueller Associates, Inc., Baltimore, MD (USA)**	
	10:29646	DOE/MC/21382—1865
AC22-76ET10532	**Chevron Research Co., Richmond, CA (USA)**	
	10:29735	DOE/ET/10532—T23
AC22-78ET13381	**Pennsylvania State Univ., University Park (USA)**	
	10:29648	DOE/ET/13381—T3
AC22-80PC30283	**Burns and Roe, Inc., Oradell, NJ (USA)**	
	10:29722	DOE/PC/30283—T5
AC22-81PC40009	**Amoco Research Center, Naperville, IL (USA)**	
	10:29623	DOE/PC/40009—T8
AC22-81PC40091	**American Cyanamid Co., Stamford, CT. Chemical Research Div.**	
	10:29624	DOE/PC/40091—T15
AC22-82PC50033	**Ingersoll-Rand Research, Inc., Princeton, NJ (USA)**	
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	10:29630	DOE/PC/50033—T4
AC22-82PC50041	**Catalytic, Inc., Wilsonville, AL (USA)**	
	10:29641	EPRI-AP—4030
AC22-82PC50053	**Orkand Corp., Silver Spring, MD (USA)**	
	10:29631	DOE/PC/50053—T5
AC22-82PC50270	**TRW Space and Technology Group, Redondo Beach, CA (USA)**	
	10:29713	DOE/PC/50270—T6
AC22-83PC60270	**Pennsylvania State Univ., University Park (USA). Center for Air Environment Studies**	
	10:29669	DOE/PC/60270—T1
	Pennsylvania State Univ., University Park (USA). Noise Control Lab.	
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AC22-83PC60789	**Institute of Gas Technology, Chicago, IL (USA)**	
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AH01-85NE34130	**American Nuclear Society. Florida Section**	
	10:30673	DOE/NE/34130—1-Vol.1
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AI01-76ET20320	**National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center**	
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AI01-77CS51017	**Society of Automotive Engineers, Inc., Warrendale, PA (USA)**	
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AI01-77CS51040	**Society of Automotive Engineers, Inc., Warrendale, PA (USA)**	
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AI01-78CS54209	**Jet Propulsion Lab., Pasadena, CA (USA)**	
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AI01-81ER60001	**Univ. of Florida, Gainesville**	
	10:32150	Crop Science 25 NO. 2. 333-339 (Mar-Apr 1985).
AI01-83PE70494	**Pechan (E.H.) and Associates, Inc., Springfield, VA (USA)**	
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AI04-80AL12726	**Battelle Columbus Labs., OH (USA)**	
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AI05-83ER40112	**Naval Research Lab., Washington, DC (USA)**	
	10:32991	DOE/ER/40112—T1
AI08-76DP00474	**Geological Survey, Denver, CO (USA)**	
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AI08-78ET44802	**Geological Survey, Denver, CO (USA)**	
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AI08-79DP40092	**Naval Research Lab., Washington, DC (USA). Plasma Physics Div.**	
	10:33026	NRL-Memo—5591
AI21-83MC20417	**Jet Propulsion Lab., Pasadena, CA (USA)**	
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AM01-80CS22061	**Energy Resources Co., Inc., Vienna, VA (USA)**	
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AM04-79CH10012	**Battelle Columbus Labs., OH (USA)**	
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AS03-81ER40029	**Univ. of California, San Diego, La Jolla**	
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AS05-76ET52023	**Virginia Univ., Charlottesville (USA). Dept. of Materials Science**	
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AS05-76EV03941	**Duke Univ., Durham, NC**	
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AS05-76EV04814	**Georgia Inst. of Tech., Atlanta (USA). School of Mechanical Engineering**	
	10:32022	DOE/EV/04814—T2
AS05-78ER06039	**Virginia Polytechnic Inst. and State Univ., Blacksburg (USA)**	
	10:31442	DOE/ER/06039—T2
AS05-78EV05855	**Florida State Univ., Tallahassee**	
	10:31770	Proceedings of the National Academy of Sciences of the United States of America 80 1767-1
AS05-79ER10424	**Kentucky Univ., Lexington (USA). Dept. of Chemistry**	
	10:31686	DOE/ER/10424—4
AS05-80ER10629	**Oklahoma Univ., Norman (USA)**	
	10:32021	DOE/ER/10624—T2
AS05-80ER10711	**Laboratory for Transport Theory and Mathematical Physics, Virginia Polytechnic Institute and State U**	
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AS05-81ER10977	**Florida Univ., Gainesville (USA). Database Systems Research and Development Center**	
	10:33110	DOE/ER/10977—T7
AS05-81ER40030	**Texas Univ., Austin (USA). Dept. of Physics**	
	10:32667	DOE/ER/40030—4A
AS05-82ER13023	**Texas A and M Univ., College Station (USA). Dept. of Chemistry**	
	10:31688	DOE/ER/13023—T1
AS05-83ER13122	**George Washington Univ., Washington, DC (USA). Dept. of Electrical Engineering and Computer Science**	
	10:33088	DOE/ER/13122—T1
AS05-83ER45035	**Virginia Univ., Charlottesville (USA). Dept. of Materials Science**	
	10:31443	DOE/ER/45035—1
AS07-77ET28393	**Utah Geological and Mineral Survey, Salt Lake City (USA)**	
	10:30569	DOE/ET/28393—T8
	10:30570	DOE/ET/28393—T9
	10:30583	DOE/ET/28393—T7
AS07-77ET28407	**Idaho Dept. of Water Resources, Boise (USA)**	
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AS07-80ER10775	**Univ. of Idaho, Moscow**	
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AS20-81LC10639	**USDOE Morgantown Energy Technology Center, WV**	
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AS20-81LC10763	**Wyoming Univ., Laramie (USA). Dept. of Chemistry**	
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AT01-76EV93011	**National Academy of Sciences - National Research Council, Washington, DC (USA). Inst. of Laboratory Animal Resources**	
	10:32209	DOE/EV/93011—T1
	10:32210	DOE/EV/93011—T2
AT02-76CH91005	**Combustion Engineering, Inc., Windsor, CT (USA)**	
	10:30755	DOE/CH/91005—T2
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AT03-76ER72018	**Stanford Univ., CA (USA). Systems Optimization Lab.**	
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AT03-76ET53064	**Electronics Research Laboratory, University of California, Berkeley, California 94720**	
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AT03-80ER52061	**California Univ., Los Angeles (USA). Center for Plasma Physics and Fusion Engineering**	
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AT03-80ER53091	**Chemical Physics Laboratory, SRI International, Menlo Park, California 94025**	
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AT03-80SF11459	**Stanford Univ., CA (USA). Stanford Geothermal Program**	
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AT03-80SF11512	**GA Technologies, Inc., San Diego, California 92138**	
	10:33058	Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films 3 NO. 3. 551-552
AT03-82ER12084	**Wellesley College, MA**	
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AT03-82ER60056	**Univ. of California, Sacramento**	
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AT03-83ER60169	**California Univ., Los Angeles (USA)**	
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AT03-84SF11963	**GA Technologies, Inc., San Diego, CA (USA)**	
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AT06-70EV71005	**Univ. of Washington, Seattle**	
	10:32234	Quarterly Review of Biology 57 NO. 4. 379-404 (Dec 1982).
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AT06-76ER70004	**Tufts Univ., Medford, MA (USA). Dept. of Physics**	
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	Oregon Univ., Eugene (USA). Inst. of Theoretical Science	
	10:32639	DOE/ER/70004—T2
AT06-84ER13170	**Washington Univ., Seattle (USA). Dept. of Mechanical Engineering**	
	10:31718	DOE/ER/13170—2
FC01-79RG10241	**Massachusetts Dept. of Public Utilities, Boston (USA)**	
	10:31162	DOE/RG/10241—T1
FC01-83MI10024	**Howard Univ., Washington, DC (USA). Fossil Energy Lab.**	
	10:29721	DOE/MI/10024—T2
FC03-82CE30701	**Sacramento Municipal Utility District, CA (USA)**	
	10:30331	DOE/CE/30701—T1
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FC03-83FE60149	**National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA)**	
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FC07-79ID12016	**Utah Div. of Water Rights, Salt Lake City (USA)**	
	10:31178	DOE/ET/12016—4
FC07-79ID12026	**Wyoming Univ., Laramie (USA). Dept. of Geology and Geophysics**	
	10:30578	DOE/ID/12026—T11
FC07-80ID12148	**Stanford Univ., CA**	
	10:30608	Journal of Petrology 24 NO. 4. 321-342 (Nov 1983).
FC07-81ID12192	**Chaffee Geothermal Ltd., Denver, CO (USA)**	
	10:30586	DOE/ID/12192—1
FC08-80NV10103	**Tucson, City of, AZ (USA)**	
	10:31424	DOE/NV/10103—1
FC08-85DP40200	**Rochester Univ., NY (USA). Lab. for Laser Energetics**	
	10:32990	DOE/DP/40200—T1
FC21-83FE60181	**North Dakota Univ., Grand Forks (USA). Energy Research Center**	
	10:29668	DOE/FE/60181—T1
FC22-83FE60339	**Southern Illinois Univ., Carbondale (USA)**	
	10:31657	DOE/FE/60339—T14
FG01-78CS30134	**ASTM, Philadelphia, PA (USA)**	
	10:30292	DOE/CS/30134—T1
FG01-80IR10334	**Littlejohn (Roy) Associates, Inc., Washington, DC (USA)**	
	10:31146	DOE/IR/10334—T1
FG01-80RG10406	**Economic and Engineering Services, Inc., Bellevue, WA (USA)**	
	10:31163	DOE/RG/10406—T4
	10:31164	DOE/RG/10406—T5
	10:31165	DOE/RG/10406—T6
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FG01-81EV10654	**Council of Energy Resource Tribes, Englewood, CO (USA)**	
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FG01-82NE37887		
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FG01-84EI19685	**Vermont State Energy Office, Montpelier (USA)**	
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FG01-84ER13259	**South Dakota School of Mines and Technology, Rapid City (USA)**	
	10:32409	DOE/ER/13259—T1
FG02-76CS60038	**Indiana Dept. of Commerce, Indianapolis (USA). Div. of Energy Policy**	
	10:31152	DOE/CS/60038—11
FG02-80CS69096	**Purdue Univ., Lafayette, IN (USA)**	
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FG02-83NE44350	**North Carolina Dept. of Natural Resources and Community Development, Raleigh (USA). Div. of Land Resources**	
	10:29915	DOE/NE/44350—1
FG02-84ER13247	**Colorado Univ., Boulder (USA)**	
	10:31682	DOE/ER/13247—1
FG02-84ER13276	**Pennsylvania State Univ., University Park (USA). Dept. of Chemical Engineering**	
	10:31656	DOE/ER/13276—1
FG02-84ER40158	**Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)**	
	10:32587	DESY—85-003
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FG02-84ER40169	**Department of Physics, University of Illinois at Chicago, Chicago, Illinois 60680**	
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FG02-84ER45087	**Univ. of Delaware, Newark**	
	10:31549	SAMPE (Society for the Advancement of Material and Process Engineers) Quarterly 16 NO. 3.
FG02-84ER45096	**Wisconsin Univ., Madison (USA)**	
	10:31444	DOE/ER/45096—1
FG02-84ER45117	**Pittsburgh Univ., PA (USA). Dept. of Metallurgical and Materials Engineering**	
	10:31528	DOE/ER/45117—1
FG02-84ER45130	**Washington Univ., St. Louis, MO (USA)**	
	10:32485	DOE/ER/45130—T1
FG02-84ER45142	**Minnesota Univ., Minneapolis (USA). School of Physics and Astronomy**	
	10:31445	DOE/ER/45142—1
FG02-84ER53179	**Syracuse Univ., NY (USA)**	
	10:32992	DOE/ER/53179—T3
FG03-78ET10737	**Waterlife West, Inc., San Diego, CA (USA)**	
	10:30369	DOE/ET/10737—T1
FG03-78SF01948	**Solar AquaSystems, Inc., Encinitas, CA (USA)**	
	10:31374	DOE/SF/01948—T1
FG03-78SF01985	**Weitzenhoff (Michael H.), Honolulu, HI (USA)**	
	10:30071	DOE/SF/01985—T1
FG03-79SF10581	**Thermo Energy Corp., Mountain View, CA (USA)**	
	10:31357	DOE/SF/10581—T1
FG03-80R950014	**Yarnell (Richard C.), Carson City, NV (USA)**	
	10:30373	DOE/R9/50014—T1
FG03-81SF11629	**Arizona State Univ., Tempe (USA). Coll. of Architecture**	
	10:31264	DOE/SF/11629—T1
FG05-80ET53088	**Texas Univ., Austin (USA). Inst. for Fusion Studies**	
	10:32888	DOE/ET/53088—177
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	10:32891	DOE/ET/53088—190
FG05-82MI10004	**Fort Valley State Coll., GA (USA)**	
	10:31175	DOE/MI/10004—T1
FG06-79R000047	**Oregon Appropriate Technology, Inc., Eugene (USA)**	
	10:30370	DOE/R0/00047—T1
FG06-84ER13202	**Washington State Univ., Pullman (USA). Dept. of Chemistry**	
	10:31594	DOE/ER/13202—1
FG07-83ID12478	**Oregon Inst. of Tech., Klamath Falls (USA). Geo-Heat Center**	
	10:30572	DOE/ID/12478—T9
	10:30606	DOE/ID/12478—T10
FG22-80PC30209	**Auburn Univ., AL (USA). Coal Conversion Lab.**	
	10:29621	DOE/PC/30209—T13
FG22-80PC30224	**Tennessee Univ., Knoxville (USA). Dept. of Chemistry**	
	10:29653	DOE/PC/30224—5
FG22-80PC30228	**Virginia Commonwealth Univ., Richmond (USA). Dept. of Chemistry**	
	10:30066	DOE/PC/30228—T10
FG22-80PC30236	**Kentucky Univ., Lexington (USA)**	
	10:29622	DOE/PC/30236—T2
FG22-81PC40778	**West Virginia Univ., Morgantown (USA). Dept. of Chemical Engineering**	
	10:29625	DOE/PC/40778—T4

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FG22-81PC40786	**Brown Univ., Providence, RI (USA). Div. of Engineering**	
	10:29626	DOE/PC/40786—6
	10:29627	DOE/PC/40786—7
FG22-81PC40792	**Rice Univ., Houston, TX (USA). Dept. of Chemistry**	
	10:29628	DOE/PC/40792—T7
FG22-81PC40810	**North Dakota Univ., Grand Forks (USA)**	
	10:29654	DOE/PC/40810—11
FG22-82PC50798	**Colorado Univ., Boulder (USA)**	
	10:29632	DOE/PC/50798—T5
	10:29633	DOE/PC/50798—T6
FG22-82PC50799	**Delaware Univ., Newark (USA). Dept. of Chemical Engineering**	
	10:29634	DOE/PC/50799—T7
FG22-82PC50801	**Southern Illinois Univ., Carbondale (USA)**	
	10:29655	DOE/PC/50801—10
FG22-82PC50804	**Purdue Univ., Lafayette, IN (USA). School of Chemical Engineering**	
	10:30067	DOE/PC/50804—9
FG22-82PC50807	**Duke Univ., Durham, NC (USA). Dept. of Chemistry**	
	10:29656	DOE/PC/50807—T9
FG22-82PC50810	**Pittsburgh Univ., PA (USA). Dept. of Chemical and Petroleum Engineering**	
	10:30068	DOE/PC/50810—T10
FG22-83PC60039	**Oklahoma State Univ., Stillwater (USA). School of Chemical Engineering**	
	10:29635	DOE/PC/60039—5
FG22-83PC60785	**Kentucky Univ., Lexington (USA)**	
	10:29657	DOE/PC/60785—7
FG22-83PC60807	**Brigham Young Univ., Provo, UT (USA). Dept. of Chemistry**	
	10:29790	DOE/PC/60807—7
FG22-83PC60809	**Arkansas State Univ., State University (USA). Dept. of Chemistry**	
	10:29723	DOE/PC/60809—T4
FG22-83PC60813	**Oklahoma State Univ., Stillwater (USA). School of Chemical Engineering**	
	10:29636	DOE/PC/60813—7
FG22-84PC70006	**Colorado School of Mines, Golden (USA). Dept. of Chemical and Petroleum Refining Engineering**	
	10:29658	DOE/PC/70006—T2
FG22-84PC70723	**Flow Industries, Inc., Kent, WA (USA)**	
	10:30644	DOE/PC/70723—T2
FG22-84PC70764	**Ohio State Univ., Columbus (USA). Dept. of Mechanical Engineering**	
	10:29724	DOE/PC/70764—2-Pt.2
FG22-84PC70776	**California Univ., Berkeley (USA). Coll. of Engineering**	
	10:29659	DOE/PC/70776—T3
FG22-84PC70786	**State Univ. of New York, Binghamton (USA). Dept. of Chemistry**	
	10:29637	DOE/PC/70786—T2
FG22-84PC70796	**Utah Univ., Salt Lake City (USA). Dept. of Fuels Engineering**	
	10:29715	DOE/PC/70796—3
FG22-84PC70811	**SRI International, Menlo Park, CA (USA)**	
	10:29638	DOE/PC/70811—2
FG22-84PC71253	**Rhode Island Univ., Narragansett (USA). Graduate School of Oceanography**	
	10:32136	DOE/PC/71253—2
FG41-81R121267	**R.J. Industries, New Canaan, CT (USA)**	
	10:31354	DOE/R1/21267—T1
FG41-81R123278	**Massachusetts Univ., Amherst (USA). Dept. of Mechanical Engineering**	
	10:30623	DOE/R1/23278—T1
FG42-79R205003	**Puerto Rico Univ., San Juan. Center for Energy and Environment Research**	
	10:30069	DOE/R2/05003—T1
FG42-80R205151	**Berg (David L.), Miller Place, NY (USA)**	
	10:31355	DOE/R2/05151—T1
FG42-80R205175	**New York State Coll. of Ceramics, Alfred (USA)**	
	10:30545	DOE/R2/05175—T1
FG43-79R306108	**Industry Consulting, Midlothian, VA (USA)**	
	10:31356	DOE/R3/06108—T1
FG43-79R306112	**Dorr (Ralph), Danville, VA (USA)**	
	10:30624	DOE/R3/06112—T1
FG43-80R302456	**Hamburg (Robert A.), Orma, WV (USA)**	
	10:30070	DOE/R3/02456—T1
FG48-79R800434	**Rocky Mountain Biological Lab., Crested Butte, CO (USA)**	
	10:30107	DOE/R8/00434—T1
FG48-79R800437	**Rasmussen (Laurence), Nederland, CO (USA)**	
	10:31263	DOE/R8/00437—T1
FG48-79R800448	**Storhaug (Leslie W.), Zahl, ND (USA)**	
	10:30371	DOE/R8/00448—T1
FG48-80R000451	**Blind Canyon Aquaranch, Hagerman, ID (USA)**	
	10:30622	DOE/R0/00451—T1
FG48-81R805032	**Mercer County Energy Development Board, Hazen, ND (USA)**	
	10:29647	DOE/R8/05032—T1
FG48-81R806041	**Viking Engineering, Garretson, SD (USA)**	
	10:30372	DOE/R8/06041—T1
NAS-7-100-954527	**Springborn Labs., Inc., Enfield, CT (USA)**	
	10:30300	DOE/JPL/954527—27/84
NAS-7-100-956312	**Mobil Solar Energy Corp., Waltham, MA (USA)**	
	10:30301	DOE/JPL/956312—11
W-31-109-ENG-38	**Solar Energy Research Inst., Golden, CO (USA)**	
	10:29665	SERI/CP—234-2506(Nov 1984).
	Argonne National Lab., IL (USA)	
	10:29744	ANL/ES—146
	Meridian Corp., Falls Church, VA (USA)	
	10:30355	ANL/OTEC-TM—4
	Argonne National Lab., IL (USA)	
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2103	NTIS (US Sales Only), PC A02/MF A01	DE85701243	MN -80	10:30817
2107	NTIS (US Sales Only), PC A03/MF A01	DE85701244	MN -80	10:30818
AERE-G-				
3161	NTIS (US Sales Only), PC A05/MF A01	DE85701257	MN -70	10:29903
3176	NTIS (US Sales Only), PC A03/MF A01	DE85701254	MN -70	10:29904
3226	NTIS (US Sales Only), PC A02/MF A01	DE85701515	MN -70	10:32382
3228	NTIS (US Sales Only), PC A02/MF A01	DE85701516	MN -70	10:29905
AERE-M-				
3399	NTIS (US Sales Only), PC A02/MF A01	DE85701250	MN -37	10:32013
3433	HMSO, London, price Pound 4.00		ND -37	10:32014
AERE-R-				
10269	HMSO, London, price Pound 4.00		ND -70	10:29906
10715	NTIS (US Sales Only), PC A05/MF A01	DE85701512	MN -37	10:32048
11103	HMSO, London, price Pound 5.00		ND -70	10:29907
11179	HMSO, London, price Pound 4.00		ND -70	10:29908
11210	HMSO, London, price Pound 6.00		ND -41	10:32818
11240	HMSO, London, price Pound 5.00		ND -70	10:30008
11268	NTIS (US Sales Only), PC A03/MF A01	DE85701255	MN -70	10:29909
11287	NTIS (US Sales Only), PC A03/MF A01	DE85701038	MN -51	10:29910
11299	NTIS (US Sales Only), PC A02/MF A01	DE85701039	MN -51	10:29911
11321	NTIS (US Sales Only), PC A03/MF A01	DE85701235	MN -41	10:32981
11397	HMSO, London, price Pound 5.00		ND -37	10:32015
11426	HMSO, London, price Pound 5.00		ND -41	10:30022
11525	NTIS (US Sales Only), PC A02/MF A01	DE85701457	MN -25	10:31431
AERE-TP-				
1061	NTIS (US Sales Only), PC A03/MF A01	DE85701258	MN -70	10:29912
AFEE-				
66-330207	NTIS (US Sales Only), PC A04; 3	DE85751225	MN -61E	10:30062
AGESTA-				
1-027	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85011305	MN -78	10:30723
AL-				
84-7	*See* AD-A-151162/5/XAB			10:32108
85-1	*See* AD-A-151367/0/XAB			10:32109
ANL-				
84-33	*See* NUREG/CR-3855-6-84	TI85000657	MN -78	10:30813
84-61-Vol.3	*See* NUREG/CR-3980-Vol.3	TI85011200	MN -78	10:31015
85-20	*See* NUREG/CR-4204	TI85011158	MN -78	10:30689
ANL/CNSV-TM-				
156	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99: DE85012287	MN -96	10:31125
ANL/EES-TM-				
276	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99: DE85012293	MN -41	10:32346
ANL/ES-				
146	NTIS, PC A07/MF A01 (GPO Dep.)	E 1.99: DE85013038	MN -92a	10:29744
ANL-HEP-CP-				
85-27	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE85012104	MN -28	10:31891

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85-1	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE85012591	STD -94ca	10:31053
ANL/OTEC-TM-				
4	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE85012291	MN -64	10:30335
ARAP-				
505	*See* NUREG/CR-4159	TI85901493	MN -11	10:32114
ASCOT-				
84-8	*See* UCRL-15662	E 1.99: DE85012960	MN -11	10:32118
AV-				
15/ 84	*See* OEFZS-4305	DE85701513	MN -70	10:29958
BARC-				
1207	NTIS (US Sales Only), PC A02/MF A01	DE85900995	MN -4	10:31591
1217	NTIS (US Sales Only), PC A02/MF A01	DE85900983	MN -4	10:31668
1224	NTIS (US Sales Only), PC A06/MF A01; 1	DE85900986	MN -4	10:29891
1231	NTIS (US Sales Only), PC A02/MF A01; 1	DE85900981	MN -80	10:30835
BDX-				
613-3230	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012014	MN -38	10:31803
613-3260	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85013254	STD -38	10:31785
BFR-R-				
10-1984	NTIS (US Sales Only), PC A07/MF A01; 1	DE85750837	MN -95e	10:31350
30-1983	NTIS (US Sales Only), PC A04/MF A01	DE85750849	MN -59A	10:30357
32-1983	NTIS (US Sales Only), PC A03/MF A01	DE85750850	MN -59A	10:30559
35-1983	NTIS (US Sales Only), PC A03/MF A01; 1	DE85750851	MN -59A	10:30560
41-1983	NTIS (US Sales Only), PC A04/MF A01; 1	DE85750852	MN -95d	10:31253
46-1983	NTIS (US Sales Only), PC A05/MF A01	DE85750853	MN -59A	10:30561
58-1983	NTIS (US Sales Only), PC A04/MF A01	DE85750854	MN -95d	10:31373
72-1983	NTIS (US Sales Only), PC A04/MF A01; 1	DE85750855	MN -95d	10:31254
75-1983	NTIS (US Sales Only), PC A05/MF A01; 1	DE85750856	MN -95d	10:31255
77-1984	NTIS (US Sales Only), PC A05/MF A01	DE85750869	MN -95d	10:31256
115-1983	NTIS (US Sales Only), PC A04/MF A01; 1	DE85750857	MN -95d	10:31257
143-1982	NTIS (US Sales Only), PC A09/MF A01; 1	DE85750858	MN -95d	10:31258
BG-Trans-				
6440	NTIS (US Sales Only), PC A02/MF A01	DE85901525	MN -92	10:32191
BHR-				
22	NTIS (US Sales Only), PC A03/MF A01	DE85701253	MN -37	10:32078
BL-				
496/ 85	*See* OEFZS-4307	DE85701470	MN -48	10:32326
BLG-				
571	NTIS (US Sales Only), PC A04/MF A01	DE85701284	MN -32	10:30770
BLL-WH-				
782-(9091.9F)	*See* N-85-16319			10:32140
BMI-				
1984-052	NTIS (US Sales Only), PC A09/MF A01	DE85751135	MN -78	10:30839
1984-053	NTIS (US Sales Only), PC A12/MF A01	DE85751129	MN -25	10:31432
1984-054	NTIS (US Sales Only), PC A06/MF A01	DE85751137	MN -80	10:31433
1984-056	NTIS (US Sales Only), PC A04/MF A01	DE85751652	MN -78	10:30840
1984-057	NTIS (US Sales Only), PC A05/MF A01	DE85751130	MN -80	10:30841
1984-064	NTIS (US Sales Only), PC A11/MF A01	DE85751624	MN -78	10:30842
2123-Vol.1	*See* NUREG/CR-4177-Vol.1	TI85901530	MN -80	10:31023
2123-Vol.2	*See* NUREG/CR-4177-Vol.2	TI85901531	MN -80	10:31024
2124	*See* NUREG/CR-4205	TI85901543	MN -78	10:31026
BMI/OCRD-				
21	NTIS, PC A11/MF A01 (GPO Dep.)	E 1.99: DE85012821	STD -70	10:32400
BNL-				
35651	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE85012529	MN -11	10:32122
35652	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE85012993	MN -25	10:33068
36253	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85011817	MN -80	10:30843
36312	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012276	MN -25	10:30732
36327	NTIS, PC A06/MF A01 (GPO Dep.)	E 1.99: DE85011826	MN -11	10:32123
36333	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE85011818	MN -11	10:32124
36366	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE85013291	MN -61F	10:30063
36367	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE85013290	MN -90d	10:29617
36390-Rev.	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012509	MN -71	10:30023
36414	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012526	MN -25	10:31434
36417	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85011832	MN -34A	10:31936
36428	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012274	MN -90i	10:32125
36430	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012514	MN -28	10:32004
36439	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85011837	MN -34B	10:32708
36450	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012527	MN -28	10:31937
36454	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85011840	MN -28	10:31938
36479	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012516	MN -28	10:31939
36483	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012515	MN -28	10:32478
36570	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85013283	MN -25	10:31435
36577	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85013289	MN -63b	10:30295
51860	NTIS, PC A05/MF A01 (GPO Dep.)	E 1.99: DE85012573	STD -95d	10:31259
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35924	NTIS, PC A02/MF A01 - GPO	TI85007923	MN -80	10:30844
36144	NTIS, PC A02/MF A01 - GPO	TI85010545	MN -78	10:30670
51848	*See* NUREG/CR-4093	TI85012310	MN -78	10:31018
51857	*See* NUREG/CR-4149	TI85012868	MN -78	10:30718
51869	*See* NUREG/CR-4201	TI85012086	MN -70B	10:29956
51873	*See* NUREG/CR-4215	TI85012785	MN -70B	10:29957
51874	*See* NUREG/CR-4221	TI85012540	MN -78	10:30690
51878	*See* NUREG/CR-4230	TI85013092	MN -80	10:31027

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51879	*See* NUREG/CR-4231	TI85013093	MN -80	10:31028
51888	*See* NUREG/CR-4254	TI85013084	MN -41	10:31029
BONN-HE-				
84-26	NTIS (US Sales Only), PC A03/MF A01	DE85751138	MN -34C	10:32622
84-35	NTIS (US Sales Only), PC A03/MF A01	DE85751626	MN -34D	10:32576
84-36	NTIS (US Sales Only), PC A03/MF A01	DE85751625	MN -34D	10:32551
BPA-				
319	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE85012565	MN -38	10:31820
BRL-MR-				
3412	*See* AD-A-151814/1/XAB			10:31827
BWC-				
83-93	NTIS (US Sales Only), PC A02/MF A01	DE85701495	MN -80	10:30724
CAPE-				
2945	USDOE-TIC, PO Bx 62, Oak Ridge, TN 37830	TI85011048	ND -70	10:31731
CBPF-NF-				
001/ 83	NTIS (US Sales Only), PC A02/MF A01	DE85701397	MN -34B	10:32848
002/ 83	NTIS (US Sales Only), PC A02/MF A01	DE85701438	MN -34B	10:32415
003/ 83	NTIS (US Sales Only), PC A04/MF A01	DE85701449	MN -4	10:32383
004/ 83	NTIS (US Sales Only), PC A03/MF A01	DE85701450	MN -4	10:32384
005/ 83	NTIS (US Sales Only), PC A02/MF A01	DE85701416	MN -34A	10:31557
006/ 83	NTIS (US Sales Only), PC A02/MF A01	DE85701441	MN -34D	10:32577
007/ 83	NTIS (US Sales Only), PC A05/MF A01	DE85701398	MN -34B	10:32849
008/ 83	NTIS (US Sales Only), PC A02/MF A01	DE85701444	MN -34D	10:32578
009/ 83	NTIS (US Sales Only), PC A02/MF A01	DE85701417	MN -34A	10:31685
010/ 83	NTIS (US Sales Only), PC A02/MF A01	DE85701436	MN -34B	10:32416
011/ 83	NTIS (US Sales Only), PC A02/MF A01	DE85701400	MN -34D	10:32632
012/ 83	NTIS (US Sales Only), PC A02/MF A01	DE85701437	MN -34B	10:32417
013/ 83	NTIS (US Sales Only), PC A02/MF A01	DE85701418	MN -34A	10:31436
016/ 83	NTIS (US Sales Only), PC A03/MF A01	DE85701419	MN -34A	10:31558
017/ 83	NTIS (US Sales Only), PC A02/MF A01	DE85701401	MN -34D	10:32633
018/ 83	NTIS (US Sales Only), PC A02/MF A01	DE85701434	MN -34B	10:32418
020/ 83	NTIS (US Sales Only), PC A03/MF A01	DE85701448	MN -34C	10:32716
021/ 83	NTIS (US Sales Only), PC A02/MF A01	DE85701402	MN -34D	10:32634
022/ 83	NTIS (US Sales Only), PC A02/MF A01	DE85701468	MN -48	10:32280
023/ 83	NTIS (US Sales Only), PC A02/MF A01	DE85701420	MN -34A	10:32830
024/ 83	NTIS (US Sales Only), PC A03/MF A01	DE85701445	MN -34D	10:32579
025/ 83	NTIS (US Sales Only), PC A02/MF A01	DE85701421	MN -34A	10:32831
CE-Trans-				
7693	NTIS (US Sales Only), PC A02/MF A01; 1	DE85900178	MN -80	10:30721
7726	NTIS (US Sales Only), PC A02/MF A01; 1	DE85901436	MN -80	10:30816
CEA-CONF-				
7330	NTIS (US Sales Only), PC A02/MF A01	DE85751331	MN -34C	10:32754
7349	NTIS (US Sales Only), PC A02/MF A01	DE85751303	MN -34C	10:31732
7352	NTIS (US Sales Only), PC A02/MF A01	DE85751337	MN -34C	10:32749
7380	NTIS (US Sales Only), PC A03/MF A01	DE85751302	MN -34C	10:32755
7384	NTIS (US Sales Only), PC A02/MF A01	DE85751349	MN -11	10:32126
7386	NTIS (US Sales Only), PC A02/MF A01	DE85751300	MN -38	10:31733
7390	NTIS (US Sales Only), PC A02/MF A01	DE85751301	MN -25	10:31437
7403	NTIS (US Sales Only), PC A03/MF A01	DE85751335	MN -34C	10:32695
7431	NTIS (US Sales Only), PC A03/MF A01	DE85751555	MN -34C	10:32850
7441	NTIS (US Sales Only), PC A02/MF A01	DE85751595	MN -38	10:31734
7442	NTIS (US Sales Only), PC A02/MF A01	DE85751594	MN -38	10:31735
7443	NTIS (US Sales Only), PC A02/MF A01	DE85751593	MN -38	10:31736
7534	NTIS (US Sales Only), PC A03/MF A01	DE85751314	MN -25	10:31550
7535	NTIS (US Sales Only), PC A03/MF A01	DE85751313	MN -25	10:31551
7536	NTIS (US Sales Only), PC A03/MF A01	DE85751316	MN -78	10:31786
7537	NTIS (US Sales Only), PC A02/MF A01	DE85751315	MN -80	10:30811
7538	NTIS (US Sales Only), PC A02/MF A01	DE85751317	MN -80	10:32394
7539	NTIS (US Sales Only), PC A02/MF A01	DE85751318	MN -80	10:30668
CEA-R-				
5282	NTIS (US Sales Only), PC A03/MF A01	DE85751221	MN -11	10:32347
CERI-CRR-				
84-1	Canadian Energy Research Institute, Calgary, Alberta			10:29645
CERL-IR-E-				
85/ 02	*See* AD-A-151708/5/XAB			10:31193
CERL-SR-E-				
85/ 06	*See* AD-A-152236/6/XAB			10:31372
CERL-TR-E-				
85/ 03	*See* AD-A-151707/7/XAB			10:31192
CERN-EP-				
82-99	NTIS (US Sales Only), PC A03/MF A01	DE85901016	MN -34D	10:32552
82-214	NTIS (US Sales Only), PC A02/MF A01	DE85900498	MN -28	10:31892
83-120	NTIS (US Sales Only), PC A02/MF A01	DE85900998	MN -34D	10:32479
83-136	NTIS (US Sales Only), PC A02/MF A01	DE85901031	MN -37	10:32016
84-125	NTIS (US Sales Only), PC A03/MF A01	DE85900486	MN -34D	10:32553
85-27	NTIS (US Sales Only), PC A02/MF A01	DE85900488	MN -28	10:31893
CERT/TR-				
82-623	NTIS, PC A07/MF A01 (GPO Dep.)	E 1.99: DE85012012	MN -11	10:31117
CFD-				
84/ 14	*See* N-85-17088			10:31721
84/ 15	*See* N-85-17089			10:31722
CNEN-				
1101	*See* KFK-3866	DE85751622	MN -11	10:32160

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CNRS-CPT-				
84-P-1608	NTIS (US Sales Only), PC A02/MF A01	DE85751291	MN -34D	10:32585
CONF-750616-	(Annual meeting of the air pollution control association, Boston, MA, USA, 16-22 Jun 1975)			
	Proc. Amer. Phytopathol. Soc., 1: 112(1975)			10:32370
CONF-7710198-	(17. international conference of mining safety research, Varna, Bulgaria, 3-7 Oct 1977)			
14-Trans.	*See* SMRE-Trans-7255	DE85901524	MN -88	10:29711
CONF-7905243-	(Conference on steam turbines for nuclear power plants, Pizen, Czechoslovakia, 15-18 May 1979)			
1-Trans.	*See* CE-Trans-7726	DE85901436	MN -80	10:30816
CONF-7909281-	(3. American Society of Civil Engineers/EMD specialty conference, Austin, TX, USA, 17-18 Sep 1979)			
1	*See* DOE/CL/98004-33	E 1.99: DE85009002	MN -79h	10:30742
CONF-791003-	(3. Eastern gas shales symposium, Morgantown, WV, USA, 1-3 Oct 1979)			
	Am. Assoc. Pet. Geol., Bull., 63: No. 9, 1575-1592(May 1982)			10:29749
CONF-8102114-	(IEA expert meeting on recommended practices for wind turbine performance testing, Geilo, Norway, 19-20 Feb 1981)			
Summ.	NTIS (US Sales Only), PC A05/MF A01; 1	DE85750807	MN -60	10:30618
CONF-8106200-	(21. annual international conference of Canadian Nuclear Association and 2. annual conference of Canadian Nuclear Society, Ottawa, Canada, 8-10 Jun 1981)			
29	*See* INFO-0080	DE85701281	MN -2	10:30727
CONF-811042-	(9. water reactor safety research information meeting, Washington, DC, USA, 26-28 Oct 1981)			
11	NTIS, PC A02 - GPO	DE85004514	MN -78	10:30845
CONF-811082-	(Workshop on tritium radiobiology and health physics, Chiba, Japan, 1 Oct 1981)			
	See NIRS-M-41	DE85781032	MN -20	10:33025
CONF-8111226-	(River and estuary mixing workshop, Hamilton, New Zealand, 17-18 Nov 1981)			
	See WSD-Misc-49	DE85780944	MN -11	10:32185
CONF-8111227-	(Workshop on aerospace technology and commercial nuclear power, Williamsburg, VA, USA, 18-20 Nov 1981)			
	American Inst. of Aeronautics and Astronautics, 1633 Broadway, New York, NY 10019	TI85010198	ND -80	10:30753
CONF-820466-	(3. workshop on grand unification, Chapel Hill, NC, USA, 15-17 Apr 1982)			
4	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012395	MN -34D	10:32635
CONF-8205296-	(Aquatic energy meeting, Aelvkarleby, Sweden, 5-6 May 1982)			
	See BFR-R-143-1982	DE85750858	MN -95d	10:31258
CONF-8205301-	(Colloquium on smectite alteration, Buffalo, NY, USA, 26-27 May 1982)			
	See SKBF-KBS-TR-83-03	DE85701272	MN -70	10:29977
CONF-8205304-	(5. Warsaw symposium on elementary particle physics, Kazimierz, Poland, 1 May 1982)			
1	*See* CERN-EP-82-99	DE85901016	MN -34D	10:32552
CONF-8206143-	(American Association of Petroleum Geologists and Society of Economic Paleontologists and Mineralogists annual convention, Calgary, Canada, 27-30 Jun 1982)			
	Am. Assoc. Pet. Geol., Bull., 66: No. 5, 630-631(May 1982)			10:29837
CONF-8208206-	(7. meeting on linear accelerators, Oho, Ibaraki, Japan, 24-26 Aug 1982)			
Summ.	*See* KEK-82-14	DE85781031	MN -28	10:31856
CONF-820942-	(Nuclear data for science and technology international conference, Antwerp, Belgium, 6-10 Sep 1982)			
40	*See* DEMO-82/13	DE85701249	MN -37	10:32018
CONF-820971-	(AIP conference on neutrino mass and gauge structure of weak interactions, Telemark, WI, USA, 22-25 Sep 1982)			
	AIP Conf. Proc., No. 99, 60-75(1983)			10:32621
	AIP Conf. Proc., No. 99, 202-206(1983)			10:32659
CONF-8209265-	(Workshop on solar assisted heat pumps with ground coupled storage, Ispra, Italy, 14-16 Sep 1982)			
	NTIS (US Sales Only), PC A24/MF A01; 1	DE85900104	MN -59A	10:30360
CONF-8209272-	(Advisory group meeting on quality assurance in biomedical neutron activation analysis, Vienna, Austria, 13-17 Sep 1982)			
Summ.	*See* IAEA-TECDOC-323	DE85780941	MN -48	10:31597
CONF-8210108-	(Detectors in heavy ion physics workshop in memory of Hans Geiger, Berlin, F.R. Germany, 6-8 Oct 1982)			
4	*See* CERN-EP-82-214	DE85900498	MN -28	10:31892
CONF-8210113-	(American Physical Society meeting on particles and fields, College Park, MD, USA, 28-30 Oct 1982)			
	AIP Conf. Proc., No. 98, 381-401(1983)			10:32575

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CONF-830116-	(Conference on elliptic problem solvers, Monterey, CA, USA, 10-12 Jan 1983)			
4	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012471	MN -32	10:33082
5	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012470	MN -32	10:33083
CONF-830292-	(Joint Army Research Office/National Science Foundation workshop on fracture, Pasadena, CA, USA, 16-18 Feb 1983)			
1	*See* UCRL-88927	E 1.99: DE85012966	MN -38	10:31726
CONF-830340-	(International conference on heavy-ion physics and nuclear physics, Catania, Italy, 21-26 Mar 1983)			
4	*See* IPNO-DRE-83-10	DE85751323	MN -34C	10:32780
CONF-830504-	(DOE single-photon ultrashort-lived radionuclides conference, Washington, DC, USA, 9-10 May 1983)			
	NTIS$17.00/MF A01	DE83017017	STD -48	10:32257
CONF-8305259-	(Canadian Nuclear Society commissioning symposium, Toronto, Ontario, Canada, 3 May 1983)			
1	*See* TP-82-36	DE85701494	MN -78	10:30719
2	*See* BWC-83-93	DE85701495	MN -80	10:30724
3	*See* RPC-E-83/47	DE85701496	MN -80	10:30731
CONF-8306110-	(2. Pisa meeting on advanced detectors, Castiglione della Pescaia, Italy, 2-8 Jun 1983)			
	Nucl. Instrum. Methods Phys. Res., Sect. A, 225: No. 3, 547-549(1 Sep 1984)			10:32044
	Nucl. Instrum. Methods Phys. Res., Sect. A, 225: No. 3, 445-453(1 Sep 1984)			10:32045
	Nucl. Instrum. Methods Phys. Res., Sect. A, 225: No. 3, 608-614(1 Sep 1984)			10:32046
	Nucl. Instrum. Methods Phys. Res., Sect. A, 225: No. 3, 615-618(1 Sep 1984)			10:32050
7	*See* CERN-EP-83-136	DE85901031	MN -37	10:32016
CONF-8306255-	(5. summer school on computing technics in physics: data bases and data structures in physics, Bechyne, Czechoslovakia, 21-30 Jun 1983)			
	Comput. Phys. Commun., 33: No. 1-3, 229-233(Aug-Sep 1984)			10:32550
CONF-8306262-	(Belgian Nuclear Society annual meeting on advanced uses of accelerators on the nuclear fuel cycle, Brussels, Belgium, 13-14 Jun 1983)			
1	*See* INIS-mf-9429	DE85780918	MN -20	10:33001
2	*See* INIS-mf-9424	DE85780936	MN -28	10:30743
4	*See* INIS-mf-9428	DE85780938	MN -28	10:31837
CONF-8306269-	(Workshop on metering-type coupling capacitor voltage transformers (CCVTs), Gaithersburg, MD, USA, 2-3 Jun 1983)			
	See EPRI-EL-3918	TI85920603	ND -97a	10:30649
CONF-830718-	(International Europhysics conference on high energy physics, Brighton, UK, 20-27 Jul 1983)			
34	*See* CERN-EP-83-120	DE85900998	MN -34D	10:32479
CONF-830811-	(Conference on quantitative NDE, Santa Cruz, CA, USA, 7-12 Aug 1983)			
21	*See* UCRL-89176	E 1.99: DE85013269	MN -38	10:31816
CONF-830822-	(12. international conference on high energy accelerators, Batavia, IL, USA, 11-16 Aug 1983)			
	1-3(Aug 1983)			10:32003
CONF-830864-	(4. international seminar on fluid/structure dynamics and containment of nuclear reactors, Chicago, IL, USA, 29-30 Aug 1983)			
	Nucl. Eng. Des., 82: No. 1, 47-62(Oct 1984)			10:30749
	Nucl. Eng. Des., 82: No. 1, 13-24(Oct 1984)			10:31040
CONF-830906-	(8. international conference on MHD electrical power generation, Moscow, USSR, 12-18 Sep 1983)			
Vol.1-Trans.	*See* DOE-tr-273-Vol.1			10:30657
Vol.1-Trans.	*See* DOE-tr-273-Vol.1			10:31182
Vol.1-Trans.	*See* DOE-tr-273-Vol.1			10:31183
Vol.1-Trans.	*See* DOE-tr-273-Vol.1			10:31184
Vol.1-Trans.	*See* DOE-tr-273-Vol.1			10:31185
CONF-830934-	(4. Pacific Basin nuclear conference, Vancouver, Canada, 11-15 Sep 1983)			
2	*See* AECL-7547	DE85701479	MN -22	10:30046
CONF-8309239-	(11. international symposium on nuclear electronics, Bratislava, Czechoslovakia, 13-16 Sep 1983)			
3	*See* JINR-11-83-531	DE85701247	MN -37	10:32053
CONF-8309242-	(Meeting of the French Society of Physics, Grenobel, France, 19-23 Sep 1983)			
2	*See* CEA-CONF-7330	DE85751331	MN -34C	10:32754
CONF-8309342-	(Fossil plant heat rate improvement workshop, St. Louis, MO, USA, 20-22 Sep 1983)			
	See EPRI-CS-4014	TI85920636	ND -90	10:30648
CONF-831012-	(International symposium on use and development of low and medium flux research reactors, Cambridge, MA, USA, 17-19 Oct 1983)			
14	*See* AECL-8252	DE85701504	MN -80	10:30834

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CONF-8310342-	(25. annual meeting of the American Society of Therapeutic Radiologists, Los Angeles, CA, USA, 3-7 Oct 1983)			
	Int. J. Radiat. Oncol., Biol. Phys., 11: No. 2, 227-233(Feb 1985)			10:32337
CONF-8310369-	(Specialists' meeting on experimental and modelling aspects of small-break LOCA, Budapest, Hungary, 3-7 Oct 1983)			
	See IAEA-TC-427/5	DE85781016	MN -78	10:30681
CONF-8310380-	(Mini-seminar on non-destructive testing, Pretoria, South Africa, 1 Oct 1983)			
	See CSIR-TSD-0009/83		ND -23	10:31793
CONF-8310382-	(BMFT/BMI workshop on hydrogen problems in reactor safety research, Bonn, Germany, 3-4 Oct 1983)			
	See BMI-1984-064	DE85751624	MN -78	10:30842
CONF-8311154-	(3. European symposium on semiconductor detectors, Munich, F.R. Germany, 14-16 Nov 1983)			
	Nucl. Instrum. Methods Phys. Res., Sect. A, 226: No. 1, 1-11(15 Sep 1984)			10:32040
	Nucl. Instrum. Methods Phys. Res., Sect. A, 226: No. 1, 129-141(15 Sep 1984)			10:32041
	Nucl. Instrum. Methods Phys. Res., Sect. A, 226: No. 1, 209-218(15 Sep 1984)			10:32042
	Nucl. Instrum. Methods Phys. Res., Sect. A, 226: No. 1, 200-203(15 Sep 1984)			10:32043
CONF-8311245-	(Symposium for researchers in nuclear geology, Pretoria, South Africa, 23-24 Nov 1983)			
Absts.	*See* PER-81	DE85780942	MN -51	10:32390
CONF-831203-	(10. symposium on fusion engineering, Philadelphia, PA, USA, 5-9 Dec 1983)			
193	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012344	MN -20	10:32982
CONF-831264-	(Workshop on accelerator physics issues for a superconducting super collider, Ann Arbor, MI, USA, 12-17 Dec 1983)			
Summ.	*See* UM-HE-84-1	E 1.99: DE85004602	MN -28	10:31873
CONF-840113-	(Symposium on space nuclear power systems, Albuquerque, NM, USA, 10-13 Jan 1984)			
11	*See* MLM-3250(OP)	E 1.99: DE85011281	MN -23	10:30056
CONF-840142-	(International symposium on heavy ion accelerators and their applications to inertial fusion, Tokyo, Japan, 23-27 Jan 1984)			
15	*See* GSI-84-17	DE85751124	MN -21	10:31944
CONF-840166-	(12. international workshop on gross properties of nuclei and nuclear excitations, Hirschegg, Austria, 16-21 Jan 1984)			
	See INIS-mf-9299	DE85780947	MN -34C	10:32662
CONF-840263-	(Workshop on sample environments in neutron and x-ray experiments, Grenoble, France, 13-15 Feb 1984)			
3	*See* CEA-CONF-7349	DE85751303	MN -34C	10:31732
CONF-840311-	(4. international symposium on heating in toroidal plasmas, Rome, Italy, 21-28 Mar 1984)			
18	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85011576	MN -20a	10:32983
CONF-840395-	(Workshop on semi-classical methods in nuclear physics, Grenoble, France, 5-8 Mar 1984)			
3	*See* ISN-84-13	DE85751304	MN -34C	10:32783
4	*See* ISN-84-14	DE85751309	MN -34C	10:32784
5	*See* ISN-84-15	DE85751310	MN -34C	10:32785
6	*See* ISN-84-16	DE85751311	MN -34C	10:32786
7	*See* ISN-84-17	DE85751312	MN -34C	10:32787
8	*See* ISN-84-12	DE85751334	MN -34C	10:32782
CONF-8403127-	(5. Nordic meeting on nuclear physics, Jyvaskyla, Finland, 12-16 Mar 1984)			
6-Summ.	*See* ISN-84-22	DE85751307	MN -34C	10:32728
7-Summ.	*See* ISN-84-23	DE85751308	MN -34C	10:32729
CONF-8403180-	(OTAN conference on seismic activity in Western Europe, Brussels, Belgium, 20-22 Mar 1984)			
1	*See* CEA-CONF-7538	DE85751317	MN -80	10:32394
CONF-8403181-	(SFEN conference on simulator part in nuclear safety, Paris, France, 20-21 Mar 1984)			
1	*See* CEA-CONF-7539	DE85751318	MN -80	10:30668
CONF-8404104-	(Spring meeting of the Combustion Institute, Boulder, CO, USA, 2-3 Apr 1984)			
5	*See* DOE/ER/13170-2	E 1.99: DE85011467	MN -4	10:31718
CONF-8404147-	(ASTM symposium on measured air leakage performance of buildings, Philadelphia, PA, USA, 2-3 Apr 1984)			
3	*See* BNL-36327	E 1.99: DE85011826	MN -11	10:32123
4	*See* LBL-17001	E 1.99: DE85012549	MN -95d	10:31271
CONF-8404246-	(3. international workshop on trace element analytical chemistry in medicine and biology, Neuherberg, F.R. Germany, 16-18 Apr 1984)			
Absts.	*See* GSF-A-1/84	DE85752003	MN -48	10:32350

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CONF-840516-	(International symposium on aging in tests of safety equipment for nuclear power plants, Paris, France, 15-16 May 1984)			
7	*See* CEA-CONF-7535	DE85751313	MN -25	10:31551
8	*See* CEA-CONF-7534	DE85751314	MN -25	10:31550
9	*See* CEA-CONF-7537	DE85751315	MN -80	10:30811
10	*See* CEA-CONF-7536	DE85751316	MN -78	10:31786
CONF-8405144-	(International groundwater symposium, Montreal, Quebec, Canada, 21-23 May 1984)			
4	*See* LBL-17473	E 1.99: DE85012555	MN -11	10:32389
CONF-8405179-	(International conference on theoretical approaches to heavy ion reaction mechanisms, Paris, France, 14-18 May 1984)			
9	*See* CEA-CONF-7352	DE85751337	MN -34C	10:32749
CONF-8405312-	(Modern methods in quantum field theory conference, Amalfi, Italy, 7-12 May 1984)			
1	*See* LBL-19302	E 1.99: DE85011164	MN -34D	10:32866
CONF-840611-	(International gas turbine conference and exhibit, Amsterdam, Netherlands, 4-7 Jun 1984)			
4	*See* NASA-TM-83739	TI85901299	MN -38	10:31775
CONF-840612-	(Air Pollution Control Association annual meeting, San Francisco, CA, USA, 25-28 Jun 1984)			
18-Rev.	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85011243	MN -11	10:31118
CONF-8406167-	(25. plenary session of COSPAR, Graz, Austria, 25 Jun-7 Jul 1984)			
7	*See* N-85-17925			10:32463
CONF-8406183-	(15. international symposium on multiparticle dynamics, Lund, Sweden, 11-16 Jun 1984)			
10	*See* DESY-84-104	DE85750987	MN -34D	10:32555
CONF-8406189-	(4. international conference on ultrarelativistic nucleus-nucleus collisions - QUARK MATTER '84, Helsinki, Finland, 17-24 Jun 1984)			
10	*See* CERN-EP-84-125	DE85900486	MN -34D	10:32553
CONF-8406243-	(Europhysics conference on nuclear reactions, Crete, Greece, 24-30 Jun 1984)			
1	*See* ISN-84-25	DE85751306	MN -34C	10:32687
CONF-8406252-	(10. UIE congress on electroheat for improved economy, Stockholm, Sweden, 18-22 Jun 1984)			
75	NTIS (US Sales Only), PC A02/MF A01; 1	DE85751763	MN -95e	10:31351
CONF-840705-	(10. international conference on cryogenic engineering, Espoo, Finland, 31 Jul-3 Aug 1984)			
6	*See* CEA-CONF-7443	DE85751593	MN -38	10:31736
7	*See* CEA-CONF-7442	DE85751594	MN -38	10:31735
8	*See* CEA-CONF-7441	DE85751595	MN -38	10:31734
CONF-840708-	(International school of heavy ion physics - frontiers in nuclear dynamics course, Erice, Trapani, Italy, 16-27 Jul 1984)			
2	*See* CEA-CONF-7380	DE85751302	MN -34C	10:32755
CONF-840789-	(International conference on particles and nuclei, Heidelberg, F.R. Germany, 30 Jul-3 Aug 1984)			
9-Summ.	*See* ISN-84-27	DE85751305	MN -34C	10:32704
CONF-8407120-	(International symposium on gyrotron development, Lausanne, Switzerland, 4-6 Jul 1984)			
1	*See* IPF-84-6	DE85780960	MN -20d	10:33005
CONF-8407123-	(Advances in materials characterization II conference, Alfred, NY, USA, 29 Jul-3 Aug 1984)			
1	*See* LBL-19396	E 1.99: DE85011207	MN -25	10:31534
CONF-840803-	(3. international conference on indoor air quality and climate, Stockholm, Sweden, 20-24 Aug 1984)			
18	*See* DTH-LV-161	DE85750803	MN -95d	10:32343
CONF-840804-	(Intersociety energy conversion engineering conference, San Francisco, CA, USA, 19-24 Aug 1984)			
	Proc., Intersoc. Energy Convers. Eng. Conf., 3: 1453-1462(Aug 1984)			10:30656
	Proc., Intersoc. Energy Convers. Eng. Conf., 3: 1567-1569(Aug 1984)			10:33065
	Proc., Intersoc. Energy Convers. Eng. Conf., 3: 1560-1565(Aug 1984)			10:33066
CONF-840806-	(18. DOE nuclear airborne waste management and air cleaning conference, Baltimore, MD, USA, 13-16 Aug 1984)			
Vol.1	NTIS, PC A99/MF A01; 1 (GPO Dep.)	E 1.99: DE85012484	STD -11	10:30009
Vol.2	NTIS, PC A99/MF A01; 1 (GPO Dep.)	E 1.99: DE85012485	STD -11	10:30010
CONF-840842-	(17. international conference on low temperature physics, Karlsruhe, F.R. Germany, 15-22 Aug 1984)			
32	*See* CEA-CONF-7386	DE85751300	MN -38	10:31733
CONF-840876-	(International conference on valence fluctuations, Koln, F.R. Germany, 27-30 Aug 1984)			
5	*See* CEA-CONF-7390	DE85751301	MN -25	10:31437
CONF-8408122-	(4. international conference on nuclear war, Erice, Sicily, Italy, 19-24 Aug 1984)			
3	*See* UCRL-92523	E 1.99: DE85011363	MN -11	10:32107

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CONF-8408147-	(12. international laser radar conference, Aix-en-Provence, France, 13-27 Aug 1984)			
1	*See* CEA-CONF-7384	DE85751349	MN -11	10:32126
CONF-8408148-	(International school of atomic and nuclear heavy ion interactions, Poiana Brasov, Romania, 28 Aug-8 Sep 1984)			
1	*See* CEA-CONF-7403	DE85751335	MN -34C	10:32695
CONF-8408149-	(12. congress of Hungarian radiologists, Debrecen, Hungary, 27-29 Aug 1984)			
Absts.	*See* INIS-mf-9478	DE85780934	MN -48	10:32268
CONF-840902-	(5. ASTM-Euratom symposium on reactor dosimetry, Geesthacht, F.R. Germany, 24-28 Sep 1984)			
19	*See* GKSS-84/E/47	DE85751617	MN -25	10:31447
CONF-840910-	(10. international conference on plasma physics and controlled nuclear fusion research, London, UK, 12-19 Sep 1984)			
26	*See* IPF-84-10	DE85780958	MN -20f	10:32897
27	*See* IPF-84-9	DE85780959	MN -20d	10:33006
CONF-8409121-	(2. international conference on fatigue thresholds - Fatigue 84, Birmingham, UK, 3-7 Sep 1984)			
2	*See* LBL-18457	E 1.99: DE85009903	MN -38	10:31468
CONF-8409143-	(7. international conference on atomic masses and fundamental constants (AMCO-7), Darmstadt-Seeheim, F.R. Germany, 3-7 Sep 1984)			
11	*See* GANIL-P-84-10	DE85751329	MN -28	10:31943
CONF-8409171-	(Workshop on electron cooling, Karlsruhe, F.R. Germany, 22-26 Sep 1984)			
3	*See* CERN-EP-85-27	DE85900488	MN -28	10:31893
CONF-8409194-	(6. international workshop on photon-photon collisions, Lake Tahoe, CA, USA, 9-13 Sep 1984)			
4	*See* BONN-HE-84-36	DE85751625	MN -34D	10:32551
5	*See* BONN-HE-84-35	DE85751626	MN -34D	10:32576
CONF-8409214-	(12. international hot atom chemistry symposium, Balatonfuered, Hungary, 23-28 Sep 1984)			
Absts.	*See* INIS-mf-9480	DE85780930	MN -4	10:31709
CONF-8409215-	(6. Hungarian conference on biomedical engineering and 2. IMEKO conference on measurement in clinical medicine, Balatonfuered, Hungary, 18-20 Sep 1984)			
Absts.	*See* INIS-mf-9477	DE85780935	MN -48	10:32267
CONF-8409223-	(CERN school of computing '84, Algua Blava, Spain, 9-22 Sep 1984)			
1	*See* DESY-84-118	DE85751638	MN -34D	10:33085
CONF-8409225-	(Colloquium on heavy ion collisions, Cargese, France, 2-15 Sep 1984)			
1	*See* CEA-CONF-7431	DE85751555	MN -34C	10:32850
CONF-8410172-	(Symposium of northeastern accelerator personnel, Stony Brook, NY, USA, 15-18 Oct 1984)			
10	*See* BNL-36417	E 1.99: DE85011832	MN -34A	10:31936
CONF-8410253-	(Autumn meeting of the Dutch Association of Physics, Petten, Netherlands, 19 Oct 1984)			
Summ.	*See* INIS-mf-9632	DE85780923	MN -34C	10:32660
CONF-8410254-	(IAA '84 - seminar on instrumental activation analysis, Klucenice, Czechoslovakia, 29 Oct-1 Nov 1984)			
Absts.	*See* INIS-mf-9625	DE85780928	MN -4	10:31613
CONF-8410274-	(Diet II conference, Elmau, F.R. Germany, 14-17 Oct 1984)			
1	*See* SAND-84-2065C	E 1.99: DE85004651	MN -34A	10:32507
CONF-8410276-	(Boulder damage symposium, Boulder, CO, USA, 15-17 Oct 1984)			
1	*See* UCRL-91429	E 1.99: DE85013207	MN -25	10:31581
CONF-8411127-	(Annual conference of the IES aviation committee, Charleston, SC, USA, 13-15 Nov 1984)			
1	NTIS, PC A02; 3	DE85003060	MN -96A	10:30055
CONF-850122-	(9. annual conference on composites and advanced ceramic materials and workshop on testing methods for ceramic matrix composites, Cocoa Beach, FL, USA, 20-24 Jan 1985)			
10	*See* UCRL-91305	E 1.99: DE85013195	MN -25	10:31548
CONF-850137-	(International Society for Optical Engineering meeting, Los Angeles, CA, USA, 21-25 Jan 1985)			
3	*See* LBL-19319	E 1.99: DE85010984	MN -37	10:32057
CONF-850169-	(7. international conference on positron annihilation, New Delhi, India, 6-11 Jan 1985)			
13	*See* BNL-36414	E 1.99: DE85012526	MN -25	10:31434
CONF-850175-	(EPRI end-use metering workshop, Seattle, WA, USA, 15-16 Jan 1985)			
1	*See* PNL-SA-12863	E 1.99: DE85013042	MN -37	10:32062
CONF-850206-	(International ANS/ENS topical meeting on probabilistic safety methods and applications, San Francisco, CA, USA, 24 Feb-1 Mar 1985)			
31	*See* BNL-36253	E 1.99: DE85011817	MN -80	10:30843

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CONF-850211-	(114. AIME annual meeting (includes Society of Mining Engineers), New York, NY, USA, 24-28 Feb 1985)			
9	*See* BNL-36570	E 1.99: DE85013283	MN -25	10:31435
CONF-850240-	(Alternative energy in the Midwest: research and applications, Schaumburg, IL, USA, 21-23 Feb 1985)			
4	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85009739	MN -59B	10:30358
CONF-850279-	(Chemical decontamination on boiling water reactors, Charlotte, NC, USA, 26-28 Feb 1985)			
1	*See* BNL-NUREG-36144	TI85010545	MN -78	10:30670
CONF-850283-	(16. Southeastern international conference on combinatorics, graph theory, and computing, Boca Raton, FL, USA, 11-15 Feb 1985)			
1	*See* SAND-85-1110C	E 1.99: DE85011916	MN -32	10:33103
CONF-850301-	(12. annual energy technology conference and exposition, Washington, DC, USA, 25-27 Mar 1985)			
7	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85011420	MN -20	10:32984
CONF-850304-	(7. international symposium on ash utilization, Orlando, FL, USA, 4-7 Mar 1985)			
1	*See* DOE/FE/60181-T1	E 1.99: DE85004275	MN -90	10:29668
CONF-850307-	(3. Southern biomass energy research conference, Gainesville, FL, USA, 12-14 Mar 1985)			
1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85011411	MN -61A	10:30296
CONF-850310-	(6. topical meeting on the technology of fusion energy, San Francisco, CA, USA, 3-7 Mar 1985)			
96	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85011560	MN -20	10:32985
97	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85011559	MN -20	10:32986
99	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85011567	MN -20	10:32987
102	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012781	MN -20b	10:32988
105	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012894	MN -20	10:32989
CONF-850311-	(National Association of Corrosion Engineers annual meeting and materials performance and corrosion show, Boston, MA, USA, 25-29 Mar 1985)			
14-Draft	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85011407	MN -93A	10:31186
CONF-850312-	(SPE annual California regional meeting, Bakersfield, CA, USA, 25-29 Mar 1985)			
2	*See* LBL-18268	E 1.99: DE85012553	MN -66a	10:30573
CONF-850314-	(Waste management '85, Tucson, AZ, USA, 24-28 Mar 1985)			
49	*See* PNL-SA-12565	E 1.99: DE85010057	MN -70	10:29964
67	*See* PNL-SA-12625	E 1.99: DE85012455	MN -23	10:30053
68	*See* PNL-SA-12953	E 1.99: DE85012447	MN -70	10:29965
69	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012777	MN -70	10:29913
CONF-850315-	(Conference on antinucleon and nucleon-nucleus interactions, Telluride, CO, USA, 18-21 Mar 1985)			
2	*See* LA-UR-85-1450	E 1.99: DE85010738	MN -34C	10:32673
3	*See* BNL-36439	E 1.99: DE85011837	MN -34B	10:32708
CONF-850375-	(20. Rencontre de Moriond, Les Arcs, France, 10-23 Mar 1985)			
2	*See* SLAC-PUB-3683	E 1.99: DE85013070	MN -34D	10:32565
5	*See* UCRL-92724	E 1.99: DE85012926	MN -34B	10:32449
CONF-850376-	(Symposium on semiclassical descriptions of atomic and nuclear collisions, Copenhagen, Denmark, 25-28 Mar 1985)			
2	*See* LBL-19222	E 1.99: DE85011984	MN -34C	10:32792
CONF-850388-	(Solar buildings: realities for today - trends for tomorrow, Washington, DC, USA, 18-20 Mar 1985)			
4	*See* LA-UR-85-887	E 1.99: DE85009550	MN -59B	10:30380
10	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012779	MN -59B	10:30359
CONF-8503105-	(Orbital dynamics and applications to accelerators workshop, Berkeley, CA, USA, 7-12 Mar 1985)			
2	*See* UCRL-92532	E 1.99: DE85011849	MN -20g	10:32922
3	*See* ANL-HEP-CP-85-27	E 1.99: DE85012104	MN -28	10:31891
4	*See* FNAL/C-85/63	E 1.99: DE85012297	MN -28	10:31894
5	*See* FNAL/C-85/59	E 1.99: DE85012296	MN -28	10:31835
CONF-8503106-	(Amorphous silicon subcontractors annual review meeting, Washington, DC, USA, 21-23 Mar 1985)			
	See SERI/CP-211-2682	E 1.99: DE85008794	MN -63	10:30311
CONF-8503116-	(17. symposium on the interface of computer science and statistics, Lexington, KY, USA, 17-19 Mar 1985)			
2	*See* PNL-SA-13023	E 1.99: DE85012456	MN -32	10:33099
CONF-8503125-	(Symposium on aneuploidy: etiology and mechanisms, Washington, DC, USA, 25-29 Mar 1985)			
2	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE85011908	MN -48	10:32229
CONF-8503129-	(Symposium on algorithms, architectures and the future of scientific computation, Austin, TX, USA, 18-20 Mar 1985)			
2	*See* UCRL-92480	E 1.99: DE85011844	MN -32	10:33106
CONF-8503137-	(IAEA technical committee meeting on advances in compact toroid research, Sydney, Australia, 4-7 Mar 1985)			
1	*See* UCRL-92538	E 1.99: DE85011846	MN -20g	10:33046

Report Number	*Availability Source*	*File Number*	*Distribution Category*	*Abstract Number*
CONF-850401-	(Topical meeting on light water reactor fuel performance, Orlando, FL, USA, 21-24 Apr 1985)			
Vol.1	*See* DOE/NE/34130-1-Vol.1	E 1.99: DE85010567	STD -78	10:30673
Vol.2	*See* DOE/NE/34130-1-Vol.2	E 1.99: DE85011221	STD -78	10:30674
CONF-850405-	(2. national topical meeting on tritium technology in fission, fusion and isotopic applications, Dayton, OH, USA, 30 Apr-2 May 1985)			
8	*See* DP-MS-84-129	E 1.99: DE85011507	MN -20	10:32994
10-Rev.1	*See* UCRL-91499-Rev.1	E 1.99: DE85012969	MN -20	10:33044
CONF-850406-	(International symposium and workshop on particulate and multi-phase processes and the 16th annual meeting of the Fine Particle Society, Miami Beach, FL, USA, 22-26 Apr 1985)			
7	*See* PNL-SA-12829	TI85010966	MN -78	10:31033
8	NTIS, PC A02/MF A01 - GPO	TI85011422	MN -78	10:30846
10	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012124	MN -80	10:30847
CONF-850410-	(ANS/ENS fast reactor safety meeting, Knoxville, TN, USA, 21-24 Apr 1985)			
40	NTIS, PC A02/MF A01; 3	TI85011429	MN -79p	10:30733
41	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012115	MN -79p	10:30848
42	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85012116	MN -79p	10:30734
43	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012114	MN -79p	10:30849
46	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85012119	MN -79p	10:30836
47	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85011474	MN -79p	10:30850
48	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012110	MN -79p	10:30851
49	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85012111	MN -79p	10:30852
51	*See* SAND-84-2043C	E 1.99: TI85012354	MN -79p	10:31034
CONF-850411-	(International meeting on advances in nuclear engineering computational methods, Knoxville, TN, USA, 9-11 Apr 1985)			
12	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85011426	MN -34C	10:32798
CONF-850417-	(189. national meeting of the American Chemical Society, Miami, FL, USA, 28 Apr-3 May 1985)			
20	*See* DP-MS-84-140	E 1.99: DE85012323	MN -70	10:29920
21	*See* DP-MS-85-11	E 1.99: DE85012324	MN -70	10:29923
22	*See* DOE/ER/10982-5	E 1.99: DE85013148	MN -90a	10:31670
23	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE85012782	MN -78	10:30853
CONF-850421-	(2. spring meeting of the Materials Research Society, San Francisco, CA, USA, 15-18 Apr 1985)			
5	*See* SAND-84-2287C	E 1.99: DE85011752	MN -25	10:31579
8	*See* LBL-19466	E 1.99: DE85012605	MN -25	10:31571
9	*See* LBL-19452	E 1.99: DE85012608	MN -25	10:31570
CONF-850444-	(Newer coal technologies: implications for energy and development policies in Asia and the Pacific, Honolulu, HI, USA, 17-24 Apr 1985)			
3	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE85012123	MN -90j	10:31151
CONF-850466-	(2. symposium on the interaction of non-nuclear munitions with structures, Panama City, FL, USA, 15-19 Apr 1985)			
4-Rev.1	*See* UCRL-92010-Rev.1	E 1.99: DE85012928	MN -38	10:31798
CONF-850468-	(Seminar on power plant digital control applications, Phoenix, AZ, USA, 9-11 Apr 1985)			
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85009705	MN -79	10:30823
CONF-8504115-	(5. international conference on crystalline field effects in f-electron systems: ICCF5, Sendai, Japan, 15-18 Apr 1985)			
4	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85012122	MN -25	10:31438
CONF-8504116-	(Workshop on ion mixing and surface alloying II, Pasadena, CA, USA, 19-20 Apr 1985)			
2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85011907	MN -25	10:31427
3	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85011938	MN -25	10:31439
CONF-8504121-	(Computer graphics '85, Dallas, TX, USA, 14 Apr 1985)			
2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85011562	MN -48	10:32228
CONF-8504123-	(Cray science and engineering symposium, Bloomington, MN, USA, 14-17 Apr 1985)			
1	*See* LA-UR-85-1264	E 1.99: TI85010710	MN -78	10:30958
CONF-8504126-	(EPRI fault-tolerant systems seminar, Phoenix, AZ, USA, 1 Apr 1985)			
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85010487	MN -79	10:30858
CONF-8504133-	(International conference on hadron spectroscopy, College Park, MD, USA, 20-22 Apr 1985)			
2	*See* BNL-36450	E 1.99: DE85012527	MN -28	10:31937
CONF-8504134-	(26. Instrument Society of America modeling and simulation conference, Pittsburgh, PA, USA, 25-26 Apr 1985)			
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85011912	MN -61E	10:31177
CONF-8504135-	(15. international technical meeting on air pollution modeling and it's application, St. Louis, MO, USA, 15-19 Apr 1985)			
1	*See* UCRL-91402	E 1.99: DE85011855	MN -11	10:32149
CONF-8504136-	(New directions in X-ray scattering workshop, Asilomar, CA, USA, 3-5 Apr 1985)			
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85011572	MN -34A	10:32481

Report Number	*Availability Source*	*File Number*	*Distribution Category*	*Abstract Number*
CONF-8504138-	(IUCCP symposium, College Station, TX, USA, 1-3 Apr 1985)			
1	*See* UCRL-92731	E 1.99: DE85012930	MN -4	10:31636
CONF-8504139-	(Glancing incident optics-fabrication workshop, Annapolis, MD, USA, 1-3 Apr 1985)			
1	*See* UCRL-92682	E 1.99: DE85012918	MN -38	10:31582
CONF-850504-	(Particle accelerator conference, Vancouver, Canada, 13-16 May 1985)			
26	*See* SAND-85-0945C	E 1.99: DE85011544	MN -21	10:33039
27	*See* SAND-85-0039C	E 1.99: DE85011753	MN -28	10:31989
32	*See* SAND-85-1133C	E 1.99: DE85011995	MN -28	10:31871
33	*See* UCRL-91936	E 1.99: DE85011857	MN -28	10:31913
35	*See* BNL-36454	E 1.99: DE85011840	MN -28	10:31938
36	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85011939	MN -28	10:31940
37	*See* SAND-84-2421C	E 1.99: DE85011918	MN -28	10:31908
40	*See* UCRL-91968	E 1.99: DE85011874	MN -21	10:33045
43	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85012286	MN -28	10:32005
44	*See* SAND-85-0035C	E 1.99: DE85012358	MN -28	10:31870
46	*See* LA-UR-85-1610	E 1.99: DE85012667	MN -28	10:31900
48	*See* LA-UR-85-1640	E 1.99: DE85012648	MN -28	10:31983
49	*See* LA-UR-85-1611	E 1.99: DE85012666	MN -28	10:31979
51	*See* LA-UR-85-1613	E 1.99: DE85012664	MN -28	10:32006
52	*See* LA-UR-85-1614	E 1.99: DE85012663	MN -28	10:31980
53	*See* LA-UR-85-1615	E 1.99: DE85012662	MN -28	10:31901
54	*See* LA-UR-85-1616	E 1.99: DE85012661	MN -28	10:32824
55	*See* LA-UR-85-1624	E 1.99: DE85012653	MN -28	10:31982
56	*See* LA-UR-85-1617	E 1.99: DE85012660	MN -28	10:31862
58	*See* LA-UR-85-1622	E 1.99: DE85012655	MN -28	10:31902
60	*See* LA-UR-85-1620	E 1.99: DE85012657	MN -28	10:31981
61	*See* LA-UR-85-1619	E 1.99: DE85012658	MN -28	10:31864
62	*See* LA-UR-85-1618	E 1.99: DE85012659	MN -28	10:31863
63	*See* LA-UR-85-1605	E 1.99: DE85012672	MN -28	10:31978
65	*See* LA-UR-85-1606	E 1.99: DE85012671	MN -28	10:32496
66	*See* SLAC-PUB-3640	E 1.99: DE85013375	MN -28	10:31910
67	*See* SLAC-PUB-3617	E 1.99: DE85013378	MN -28	10:31872
71	*See* SLAC-PUB-3689	E 1.99: DE85013371	MN -28	10:31995
81	*See* BNL-36479	E 1.99: DE85012516	MN -28	10:31939
82	*See* BNL-36430	E 1.99: DE85012514	MN -28	10:32004
83	*See* SLAC-PUB-3671	E 1.99: DE85013074	MN -28	10:31994
84	*See* SLAC-PUB-3633	E 1.99: DE85013057	MN -28	10:31993
85	*See* SLAC-PUB-3673	E 1.99: DE85013073	MN -28	10:31911
86	*See* LA-UR-85-1682	E 1.99: DE85012718	MN -28	10:31904
90	*See* LA-UR-85-1654	E 1.99: DE85012706	MN -28	10:31903
106	*See* SLAC-PUB-3632	E 1.99: DE85013058	MN -28	10:31992
107	*See* LA-UR-85-1735	E 1.99: DE85012725	MN -28	10:31984
110	*See* SLAC-PUB-3616	E 1.99: DE85013062	MN -28	10:31991
111	*See* SLAC-PUB-3621	E 1.99: DE85013061	MN -28	10:31909
112	*See* LA-UR-85-1736	E 1.99: DE85012724	MN -28	10:31985
113	*See* LA-UR-85-1737	E 1.99: DE85012723	MN -28	10:31986
114	*See* LA-UR-85-1352	DE85012698	MN -28	10:31861
115	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012377	MN -28	10:31834
117	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012368	MN -28	10:31941
118	*See* LA-UR-85-1528	E 1.99: DE85012691	MN -28	10:31899
120	*See* LA-UR-85-1526	E 1.99: DE85012693	MN -28	10:31898
122	*See* BNL-36483	E 1.99: DE85012515	MN -28	10:32478
127	*See* SLAC-PUB-3610	E 1.99: DE85013063	MN -28	10:31990
152	*See* LA-UR-85-1584	E 1.99: DE85012682	MN -28	10:31977
CONF-850506-	(9. symposium on microdosimetry, Toulouse, France, 20-24 May 1985)			
4	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE85012108	MN -41	10:32819
6	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012898	MN -41	10:32017
CONF-850507-	(International conference on nuclear data for basic and applied science, Santa Fe, NM, USA, 13-17 May 1985)			
3	*See* LA-UR-85-1476	E 1.99: DE85010731	MN -34C	10:32029
7	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85011549	MN -34C	10:32756
13	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85011928	MN -34C	10:32709
14	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85011551	MN -80	10:30838
15	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85011471	MN -34C	10:32717
16	*See* LBL-18944	E 1.99: DE85012603	MN -34C	10:32691
17	*See* LA-UR-85-1730	E 1.99: DE85012728	MN -80	10:30778
18	*See* LA-UR-85-1961	E 1.99: DE85012751	MN -34C	10:32690
19	*See* UCRL-92666	E 1.99: DE85012912	MN -34C	10:32733
20	*See* UCRL-92672	E 1.99: DE85012916	MN -34B	10:32448
23	*See* LA-UR-85-1729	E 1.99: DE85012729	MN -78	10:30715
24	*See* LA-UR-85-1602	E 1.99: DE85012674	MN -15	10:29890
26	*See* LA-UR-85-1742	E 1.99: DE85012750	MN -34B	10:32427
CONF-850512-	(Beijing international symposium on hydrogen systems, Beijing, China, 7-11 May 1985)			
1	*See* BNL-36367	E 1.99: DE85013290	MN -90d	10:29617
2	*See* BNL-36366	E 1.99: DE85013291	MN -61F	10:30063
CONF-850515-	(7. annual industrial energy technology conference, Houston, TX, USA, 13-15 May 1985)			
1	*See* EGG-M-13085	E 1.99: DE85012331	MN -95f	10:31359

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CONF-850536-	(American Ceramic Society annual meeting, Cincinnati, OH, USA, 5-9 May 1985)			
2	*See* N-85-15878			10:31535
3	*See* DP-MS-85-9	E 1.99: DE85012328	MN -70B	10:29922
4	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85012367	MN -80	10:30819
CONF-850556-	(7. symposium on safeguards and nuclear material management, Liege, Belgium, 21-23 May 1985)			
3	*See* PNL-SA-12710	TI85012446	MN -15	10:30043
5	*See* LA-UR-85-1436	E 1.99: DE85012697	MN -15	10:29887
6	*See* LA-UR-85-1683	E 1.99: DE85012717	MN -15	10:30038
7	*See* LA-UR-85-1684	E 1.99: DE85012716	MN -15	10:30039
8	*See* LA-UR-85-1685	E 1.99: DE85012715	MN -15	10:30040
9	*See* LA-UR-85-1649	E 1.99: DE85012710	MN -15	10:30037
10	*See* GAT-NM-119	E 1.99: DE85013128	MN -16	10:30034
CONF-850558-	(Conference on lasers and electro-optics, Baltimore, MD, USA, 21-24 May 1985)			
2	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012883	MN -38	10:31804
CONF-850560-	(Workshop on autoionization of atoms and small molecules, Argonne, IL, USA, 2-3 May 1985)			
4	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85012299	MN -34A	10:32480
5	*See* UCRL-92713	E 1.99: DE85012929	MN -34A	10:32509
CONF-850570-	(IAEA specialists' meeting on gas cooled reactors, Oak Ridge, TN, USA, 13-15 May 1985)			
1	*See* DOE/HTGR-85-026	E 1.99: DE85011737	MN -77	10:30860
5	NTIS, PC A02/MF A01 - GPO	TI85012098	MN -77	10:30854
6	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012102	MN -77	10:30855
CONF-850573-	(Topical conference on basic properties of optical materials, Gaithersburg, MD, USA, 7-9 May 1985)			
3	*See* UCRL-15659	E 1.99: DE85012968	MN -37	10:31766
CONF-850578-	(DOE/BES contractors' combustion meeting, Lake Geneva, WI, USA, 22-24 May 1985)			
3	*See* LBL-19583	E 1.99: DE85012604	MN -4	10:31720
CONF-850599-	(35. electronics components conference, Washington, DC, USA, 20-22 May 1985)			
2	*See* BDX-613-3230	E 1.99: DE85012014	MN -38	10:31803
CONF-8505100-	(7. US symposium on compact toroid research, Santa Fe, NM, USA, 21-23 May 1985)			
2	*See* LA-UR-85-1818	E 1.99: DE85012735	MN -20b	10:33020
5	*See* LA-UR-85-1789	E 1.99: DE85012744	MN -20d	10:32905
7	*See* LA-UR-85-1792	E 1.99: DE85012739	MN -20d	10:33019
CONF-8505103-	(Health Physics Society annual meeting, Chicago, IL, USA, 26-31 May 1985)			
4	*See* PNL-SA-12901	E 1.99: DE85013278	MN -37	10:32033
CONF-8505113-	(33. annual scientific meeting of the Radiation Research Society, Los Angeles, CA, USA, 5-9 May 1985)			
1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012101	MN -34	10:32799
CONF-8505115-	(SPE/DOE symposium on low permeability reservoirs, Denver, CO, USA, 19-22 May 1985)			
5	*See* SAND-85-0990C	E 1.99: DE85011707	MN -11	10:29811
CONF-8505122-	(EPES '85 - energy, power and environmental systems international conference, Santa Barbara, CA, USA, 29-31 May 1985)			
1	*See* SAND-85-0173C	E 1.99: DE85012355	MN -38	10:31748
CONF-8505131-	(Spring DECUS symposium, New Orleans, LA, USA, 27-31 May 1985)			
2	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85011306	MN -21	10:33084
3	*See* UCRL-92624	E 1.99: DE85011856	MN -32	10:33107
4	*See* LA-UR-85-1817	E 1.99: DE85012736	MN -32	10:33098
CONF-8505135-	(2. national utility energy efficiency conference, Oakland, CA, USA, 21-23 May 1985)			
1	*See* SERI/TP-251-2648	E 1.99: DE85002937	MN -95a	10:31295
CONF-8505137-	(6. IFAC workshop on distributed computer control systems, Monterey, CA, USA, 20-22 May 1985)			
1	*See* UCRL-92502	E 1.99: DE85011847	MN -41	10:32119
CONF-8505138-	(Materials and mechanisms of superconductivity conference, Ames, IA, USA, 29-31 May 1985)			
1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85011935	MN -38	10:31440
2	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012284	MN -25	10:31525
3	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012896	MN -25	10:31526
4	*See* LA-UR-85-1648	E 1.99: DE85012711	MN -25	10:31467
CONF-8505139-	(9. annual actinide separations workshop, Richland, WA, USA, 22-24 May 1985)			
2	*See* DP-MS-85-57	E 1.99: DE85012326	MN -4	10:29893
3	*See* LA-UR-85-1705	E 1.99: DE85012714	MN -10	10:30041
CONF-8505141-	(The Institute of Management Sciences/Operations Research Society of America meeting, Boston, MA, USA, 1 May 1985)			
1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85011932	MN -96	10:29741
CONF-8505142-	(American Association of Crystal Growth workshop on purification of materials for crystal growth and glass processing, Watsonville, CA, USA, 14-17 May 1985)			
1	*See* EGG-10282-2054	E 1.99: DE85011684	MN -25	10:32023

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CONF-8505143-	(American Industrial Hygiene conference, Las Vegas, NV, USA, 19-24 May 1985)			
	Am. Ind. Hyg. Assoc. J., 46: No. 2, 80-84(Feb 1985)			10:32151
CONF-8505146-	(Southern Regional Science Association meeting, Washington, DC, USA, 9-11 May 1985)			
1	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE85012902	MN -95a	10:31190
CONF-8505147-	(Symposium on small hydropower and fisheries, Denver, CO, USA, 5-7 May 1985)			
2	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012886	MN -11	10:30243
CONF-8505148-	(National conference on perspectives on nonpoint source pollution, Kansas City, MO, USA, 19-22 May 1985)			
1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85013111	MN -11	10:30244
CONF-8505149-	(National conference on hazardous wastes and environmental emergencies, Cincinnati, OH, USA, 14-16 May 1985)			
1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE85012903	MN -11	10:31119
CONF-8505150-	(Symposium on numerical simulation of combustion phenomena, Sophia-Antipolis, France, 21-24 May 1985)			
1	*See* LA-UR-85-1728	E 1.99: DE85012730	MN -92b	10:29804
CONF-850606-	(American Society of Heating, Refrigerating and Air-Conditioning Engineers' semiannual meeting, Honolulu, HI, USA, 23-27 Jun 1985)			
5	*See* BNL-36333	E 1.99: DE85011818	MN -11	10:32124
8	*See* SERI/TP-253-2562	DE85002945	MN -59A	10:30402
CONF-850608-	(Spring conference on experimental mechanics, Las Vegas, NV, USA, 9-13 Jun 1985)			
3	*See* UCRL-92050	E 1.99: DE85011845	MN -38	10:31751
CONF-850610-	(Annual meeting of the American Nuclear Society, Boston, MA, USA, 9-14 Jun 1985)			
2	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85006194	MN -79	10:30735
6	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85006196	MN -78	10:30856
12-Summ.	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85006224	MN -79c	10:30736
22	*See* BNL-NUREG-35924	TI85007923	MN -80	10:30844
28	*See* CONF-8504126-1	E 1.99: DE85010487	MN -79	10:30858
CONF-850616-	(5. IEEE pulsed power conference, Washington, DC, USA, 10-12 Jun 1985)			
1	*See* SAND-84-2398C	E 1.99: DE85012027	MN -28	10:31907
2	*See* SAND-84-2412C	E 1.99: DE85012026	MN -28	10:31868
4	*See* SAND-84-2458C	E 1.99: DE85012356	MN -38	10:30667
5	*See* SAND-84-2560C	E 1.99: DE85012809	MN -21	10:33038
6	*See* SAND-84-2578C	E 1.99: DE85012813	MN -38	10:31811
7	*See* SAND-84-2457C	E 1.99: DE85012826	MN -28	10:31869
9	*See* SAND-84-2513C	DE85012862	MN -38	10:31810
10	*See* SAND-84-2434C	E 1.99: DE85012867	MN -21	10:33032
11	*See* SAND-84-2559C	E 1.99: DE85012861	MN -21	10:33037
12	*See* SAND-84-2392C	E 1.99: DE85012863	MN -28	10:31988
13	*See* SAND-84-2374C	E 1.99: DE85012866	MN -38	10:31809
14	*See* LA-UR-85-1939	E 1.99: DE85012755	MN -38	10:31806
15	*See* LA-UR-85-1936	E 1.99: DE85012756	MN -38	10:31805
18	*See* SAND-84-2395C	E 1.99: DE85012812	MN -28	10:31867
21	*See* SAND-84-2523C	E 1.99: DE85013119	MN -21	10:33035
27	*See* SAND-84-2520C	E 1.99: DE85012840	MN -21	10:33034
29	*See* SAND-84-2537C	E 1.99: DE85012841	MN -21	10:33036
30	*See* SAND-84-2519C	E 1.99: DE85012860	MN -21	10:33033
37	*See* SAND-84-2638C	E 1.99: DE85013436	MN -38	10:31812
38	*See* SAND-84-2544C	E 1.99: DE85013438	MN -38	10:32063
CONF-850629-	(International conference on analytical chemistry in nuclear technology, Karlsruhe, F.R. Germany, 4-7 Jun 1985)			
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CONF-850646-	(2. international specialists meeting on small break LOCA analyses in LWRs, Pisa, Italy, 24-26 Jun 1985)			
3	*See* EGG-M-11485	DE85012615	MN -78	10:30862
CONF-850671-	(26. U.S. symposium on rock mechanics, Rapid City, SD, USA, 26-28 Jun 1985)			
18	*See* UCRL-92229	E 1.99: DE85012971	MN -70	10:32408
CONF-8506115-	(2. international congress of applied pattern recognition, Amsterdam, Netherlands, 19-21 Jun 1985)			
1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85011906	MN -48	10:32213
CONF-8506140-	(13. photovoltaic concentrator project integration meeting, Albuquerque, NM, USA, 4-5 Jun 1985)			
Absts.	*See* SAND-85-0791/1	E 1.99: DE85013253	MN -63	10:30310
CONF-850706-	(8. international symposium on detonation, Albuquerque, NM, USA, 15-19 Jul 1985)			
1	*See* LA-UR-84-2753	E 1.99: DE84016822	MN -34	10:32082
2	*See* UCRL-92102	E 1.99: DE85007266	MN -45	10:32096
4	*See* LA-UR-85-1088	E 1.99: DE85009598	MN -45	10:32087
5	*See* LA-UR-85-769	E 1.99: DE85009593	MN -45	10:32084
6	*See* LA-UR-85-742	E 1.99: DE85009587	MN -45	10:32083
7	*See* LA-UR-85-1122	E 1.99: DE85009606	MN -45	10:32088
8	*See* LA-UR-85-860	E 1.99: DE85009581	MN -45	10:32085

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10	*See* LA-UR-85-1130	E 1.99: DE85009609	MN -45	10:32089
15	*See* SAND-84-1825C	E 1.99: DE85009982	MN -45	10:32092
18	*See* LA-UR-85-1390	E 1.99: DE85010750	MN -45	10:32090
19	*See* SAND-85-0761C	E 1.99: DE85011726	MN -45	10:32095
20	*See* SAND-84-1860C	E 1.99: DE85011823	MN -45	10:32094
CONF-850709-	(National computer conference, Chicago, IL, USA, 22-26 Jul 1985)			
1	*See* LA-UR-84-3370	E 1.99: DE85002419	MN -32	10:33096
CONF-850711-	(22. annual conference on nuclear and space radiation effects, Monterey, CA, USA, 22-24 Jul 1985)			
2	*See* SAND-85-0632C	E 1.99: DE85008419	MN -34B	10:31814
3	*See* SAND-85-0385C	E 1.99: DE85009340	MN -23	10:32829
4	*See* SAND-85-0564C	E 1.99: DE85009444	MN -23	10:32809
CONF-850712-	(21. AIAA/ASME/SAE joint propulsion conference, Monterey, CA, USA, 8-10 Jul 1985)			
1	*See* LA-UR-84-3578	E 1.99: DE85003755	MN -96	10:32056
4	*See* LA-UR-85-1149	E 1.99: DE85010771	MN -38	10:31742
CONF-850714-	(Symposium on plasma chemistry, Eindhoven, Netherlands, 1-5 Jul 1985)			
1	*See* LA-UR-85-981	E 1.99: DE85009634	MN -25	10:31533
CONF-850723-	(7. international system safety conference, San Jose, CA, USA, 25-29 Jul 1985)			
1	*See* LA-UR-85-558	E 1.99: DE85007665	MN -80	10:30957
2	*See* LA-UR-85-828	E 1.99: DE85009575	MN -32	10:33097
CONF-850736-	(American Physical Society topical conference on shock waves in condensed matter, Spokane, WA, USA, 22-26 Jul 1985)			
1	*See* SAND-85-0391C	E 1.99: DE85008468	MN -34	10:33100
CONF-850742-	(International Pyrotechnics Society symposium, Karlsruhe, F.R. Germany, 3-5 Jul 1985)			
1	*See* LA-UR-85-1023	E 1.99: DE85009620	MN -45	10:32086
CONF-850744-	(National conference on environmental engineering, Boston, MA, USA, 1-3 Jul 1985)			
1	*See* DP-MS-84-141	E 1.99: DE85010067	MN -70	10:29921
CONF-850745-	(4. international conference on numerical methods in laminar and turbulent flow, Swansea, UK, 8-12 Jul 1985)			
5	*See* UCRL-92505	E 1.99: DE85010926	MN -38	10:31781
6	*See* UCRL-91617	E 1.99: DE85009904	MN -38	10:31780
7	*See* LA-UR-85-1049	E 1.99: DE85009625	MN -34	10:32539
8	*See* DP-MS-85-29	E 1.99: DE85010068	MN -70	10:31560
CONF-850752-	(South African symposium on numerical math, Durban, South Africa, 8 Jul 1985, 8 Jul 1985)			
1	*See* SAND-85-0725C	E 1.99: DE85010122	MN -32	10:33101
CONF-850917-	(Topical meeting on criticality safety and the storage of fissile material, Jackson, WY, USA, 9-12 Sep 1985)			
1	*See* DP-MS-85-31	E 1.99: DE85011508	MN -46	10:31737
CONF-851043-	(18. IEEE photovoltaic specialists conference, Las Vegas, NV, USA, 21-25 Oct 1985)			
1	*See* BNL-36577	E 1.99: DE85013289	MN -63b	10:30295
CONF-851103-	(International symposium on fundamental aspects of gas-liquid flows, Miami, FL, USA, 17-21 Nov 1985)			
2	*See* LA-UR-85-457	E 1.99: DE85007703	MN -78	10:30956
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1764-408	*See* DOE/ER/40105-T3	E 1.99: DE85012392	MN -34A	10:32591
1764-439	*See* CONF-820466-4	E 1.99: DE85012395	MN -34D	10:32635
1764-441	*See* UR-824	E 1.99: DE85012394	MN -34D	10:32566
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2426-206	*See* DOE/CH/91005-T3	E 1.99: DE85004524	MN -78	10:30756
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CSIR-TSD-				
0009/ 83	CSIR, P.O. Box 395, Pretoria, 0001, South Africa		ND -23	10:31793
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58	CSIRO, Division of Geomechanics, Mount Waverley, Australia			10:29694
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83	*See* CEA-CONF-7534		DE85751314	MN -25	10:31550
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T5	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012535	MN -61G	10:30299
DOE/ER/04999-				
T2	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE85012907	MN -34	10:32852
DOE/ER/06039-				
T2	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85007352	MN -25	10:31442
DOE/ER/10345-				
T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85004305	MN -4	10:30065

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DOE/ER/10424-				
4	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85011748	MN -4	10:31686
DOE/ER/10457-				
4-Rev.	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85006883	MN -61	10:31687
DOE/ER/10488-				
T1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85005880	MN -90c	10:29618
DOE/ER/10511-				
T4	NTIS, PC A02; 3	DE85011231	MN -25	10:31543
T6	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85011233	MN -25	10:31544
DOE/ER/10556-				
95	NTIS, PC A05/MF A01 (GPO Dep.)	E 1.99: DE85011564	MN -25	10:31428
DOE/ER/10624-				
T2	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99: DE85007105	MN -37	10:32021
DOE/ER/10718-				
5	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85013135	MN -32	10:33086
DOE/ER/10753-				
5	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012857	MN -34B	10:32419
DOE/ER/10954-				
2	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85011900	MN -32	10:33087
DOE/ER/10977-				
T7	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE85006081	MN -32	10:33110
DOE/ER/10982-				
4	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85013147	MN -90a	10:31669
5	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE85013148	MN -90a	10:31670
DOE/ER/12075-				
4FR	NTIS, PC A18/MF A01; 1 (GPO Dep.)	E 1.99: DE85012560	MN -80	10:30671
DOE/ER/13023-				
T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85009696	MN -4	10:31688
DOE/ER/13122-				
T1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85013385	MN -32	10:33088
DOE/ER/13137-				
T1	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE85012465	MN -34A	10:32484
DOE/ER/13163-				
6	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE85010390	MN -38	10:31794
DOE/ER/13170-				
2	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85011467	MN -4	10:31718
DOE/ER/13202-				
1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE85010615	MN -4	10:31594
DOE/ER/13247-				
1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85013082	MN -37	10:31682
DOE/ER/13259-				
T1	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99- DE85012308	MN -11	10:32409
DOE/ER/13276-				
1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012254	MN -4	10:31656
DOE/ER/40030-				
4A	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE85007065	MN -34D	10:32667
DOE/ER/40048-				
126	NTIS, PC A07; 3	DE85011445	MN -34C	10:32679
DOE/ER/40105-				
462	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE85012334	MN -34D	10:32590
T2	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85011547	MN -34D	10:32559
T3	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012392	MN -34A	10:32591
DOE/ER/40112-				
T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85012980	MN -21	10:32991
DOE/ER/45016-				
1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012541	MN -25	10:31527
DOE/ER/45035-				
1	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE85011749	MN -25	10:31443
DOE/ER/45096-				
1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012401	MN -25	10:31444
DOE/ER/45117-				
1	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE85013481	MN -25	10:31528
DOE/ER/45130-				
T1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85013448	MN -34A	10:32485
DOE/ER/45142-				
1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85013367	MN -25	10:31445
DOE/ER/53179-				
T3	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE85009415	MN -20g	10:32992
DOE/ER/60036-				
T2-Vol.1	NTIS, PC A06/MF A01 (GPO Dep.)	E 1.99: DE85013323	MN -91	10:29813
T2-Vol.2	NTIS, PC A08/MF A01; 1 (GPO Dep.)	E 1.99: DE85013324	MN -91	10:29841
T2-Vol.3	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99: DE85013325	MN -91	10:29842
DOE/ER/60081-				
T2	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99: DE85011532	MN -11	10:32130
DOE/ER/60084-				
4	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE85011185	MN -48	10:31696
T2	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85008306	MN -48	10:32258
DOE/ER/60106-				
2	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99: DE85012987	MN -11	10:32131
DOE/ER/60169-				
T2	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85011703	MN -41	10:32296
DOE/ER/60182-				
1	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99: DE85012412	MN -11	10:32385

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DOE/ER/70004-				
T2	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99: DE85011480	MN -34D	10:32639
T3	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85011499	MN -34D	10:32592
DOE/ET/10532-				
T23	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE85012359	STD -90d	10:29735
DOE/ET/10737-				
T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85012217	MN -59B	10:30369
DOE/ET/12016-				
4	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85013311	STD -66d	10:31178
DOE/ET/13077-				
105	NTIS, PC A05/MF A01 (GPO Dep.)	E 1.99: DE85000128	STD -92a	10:29751
DOE/ET/13381-				
T3	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE85002197	MN -90a	10:29648
DOE/ET/20624-				
T8	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85006777	MN -63	10:30333
T9	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85006775	MN -63	10:30334
T10	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85006772	MN -63	10:30335
DOE/ET/28393-				
T7	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE85009344	MN -66	10:30583
T8	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99: DE85009541	MN -66	10:30569
T9	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85009346	MN -66	10:30570
DOE/ET/28407-				
T5	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99: DE85012905	MN -66a	10:30571
DOE/ET/34031-				
18	NTIS (US Sales Only), PC A05/MF A01; 1 (GPO Dep.)	E 1.99: DE85009056	STD -78	10:30672
DOE/ET/51017-				
T2	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE85012352	MN -20a	10:32885
DOE/ET/52023-				
34	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85011745	MN -25	10:31446
DOE/ET/53051-				
79	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012062	STD -20f	10:32886
DOE/ET/53072-				
T1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85011579	MN -20	10:32887
DOE/ET/53088-				
177	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85013122	MN -20g	10:32888
179	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85013124	MN -20g	10:32889
187	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85013120	MN -20g	10:32890
190	NTIS, PC A07/MF A01 (GPO Dep.)	E 1.99: DE85013121	MN -20a	10:32891
DOE/EV/02986-				
T1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE85012407	MN -11	10:32132
DOE/EV/03221-				
81	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE85013327	MN -48	10:32349
DOE/EV/04814-				
T2	NTIS, PC A06/MF A01 (GPO Dep.)	E 1.99: DE85010302	MN -41	10:32022
DOE/EV/10566-				
T1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85005702	MN -48	10:32371
DOE/EV/10610-				
4	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE85013326	MN -90i	10:32133
DOE/EV/93011-				
T1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85011743	MN -48	10:32209
T2	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85011744	MN -48	10:32210
DOE/FE-				
0048	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE85012754	STD -92b	10:29798
DOE/FE/60181-				
T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85004275	MN -90	10:29668
DOE/FE/60339-				
T14	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE85011969	MN -90e	10:31657
DOE/HTGR-				
85-026	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85011737	MN -77	10:30860
DOE/ID/12026-				
T11	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99: DE85013004	STD -66a	10:30578
DOE/ID/12192-				
1	NTIS, PC A13/MF A01; 1 (GPO Dep.)	E 1.99: DE84014797	STD -66g	10:30586
DOE/ID/12478-				
T9	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE85009786	MN -66	10:30572
T10	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE85013125	MN -66g	10:30606
DOE/IE-				
0003/ 1	NTIS, PC A09/MF A01; 1 (GPO Dep.)	E 1.99: DE85013410	MN -98F	10:31159
DOE/IR/10334-				
T1	NTIS, PC A12/MF A01; 1 (GPO Dep.)	E 1.99: DE85012411	MN -13	10:31146
DOE/JPL/954527-				
27/ 84	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99: DE85012831	STD -63b	10:30300
DOE/JPL/956312-				
11	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE85013589	STD -63b	10:30301
DOE/LC/10763-				
1706	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE85004982	STD -91	10:29818
DOE/LC/11003-				
1805	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99: DE85008587	STD -91	10:29847
DOE/MC/20182-				
T1	NTIS, PC A06/MF A01 (GPO Dep.)	E 1.99: DE85011488	MN -90e	10:29719
DOE/MC/20184-				
1829	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE85011388	STD -92a	10:29695

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DOE/MC/20334-				
T19	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012799	MN -90i	10:31773
DOE/MC/20342-				
1838	NTIS, PC A10/MF A01; 1 (GPO Dep.)	E 1.99: DE85008607	STD -92a	10:29805
DOE/MC/20417-				
1825	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE85009891	STD -90c	10:29619
DOE/MC/21233-				
T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85002699	MN -90h	10:29720
DOE/MC/21377-				
T1	NTIS, PC A05/MF A01 (GPO Dep.)	E 1.99: DE85013357	MN -90c	10:29620
DOE/MC/21382-				
1865	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99: DE85011949	STD -90f	10:29646
DOE/METC-				
85/ 0219	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE85001995	STD -92a	10:29745
85/ 0221	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85001997	STD -92a	10:29752
DOE/MI/01015-				
T1	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE85012620	MN -13	10:33111
DOE/MI/10004-				
T1	NTIS, PC A05/MF A01 (GPO Dep.)	E 1.99: DE85012544	MN -98G	10:31175
DOE/MI/10024-				
T2	NTIS, PC A09/MF A01; 1 (GPO Dep.)	E 1.99: DE85010813	MN -90e	10:29721
DOE/NASA/20320-				
64	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85013105	STD -60	10:30621
DOE/NBB-				
0070	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE85012341	STD -11	10:32134
DOE/NBM-				
5009058	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE85009058	MN -98E	10:31160
DOE/NE/32123-				
T1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE85013079	MN -33	10:30837
DOE/NE/34130-				
1-Vol.1	NTIS (US Sales Only), PC A15/MF A01; 1 (GPO Dep.)	E 1.99: DE85010567	STD -78	10:30673
1-Vol.2	NTIS (US Sales Only), PC A16/MF A01; 1 (GPO Dep.)	E 1.99: DE85011221	STD -78	10:30674
DOE/NE/44350-				
1	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99: DE85013412	MN -70	10:29915
DOE/NV/10103-				
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85012774	MN -96	10:31424
DOE/NV/10150-				
6	NTIS, PC A05/MF A01 (GPO Dep.)	E 1.99: DE85009464	STD -66a	10:30599
DOE/NV/10250-				
19	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE85012289	MN -70	10:29916
DOE/OR/20722-				
27-Vol.1	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99: DE85009915	STD -70A	10:30024
27-Vol.3	NTIS, PC A09/MF A01; 1 (GPO Dep.)	E 1.99: DE85009917	STD -70A	10:30025
DOE/OR/21400-				
T101	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE85008358	MN -13	10:33070
T123	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE85012486	MN -11	10:32135
T124	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012778	MN -2	10:30751
T125	NTIS MF A01; 2 (GPO Dep.)	E 1.99: DE85012346	MN -20	10:32993
T126	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99: DE85011807	MN -70	10:29917
T127	NTIS, PC A07/MF A01 - GPO	TI85013046	MN -78	10:30675
DOE/OR/21403-				
T1	NTIS, PC A14/MF A01; 1	DE85012881	MN -92	10:29799
T2	NTIS, PC A18/MF A01; 1 (GPO Dep.)	E 1.99: DE85012545	MN -92	10:29800
DOE/PC/30209-				
T13	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85012855	MN -90d	10:29621
DOE/PC/30224-				
5	NTIS, PC A09/MF A01; 1 (GPO Dep.)	E 1.99: DE85013165	MN -90a	10:29653
DOE/PC/30228-				
T10	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85013156	MN -90d	10:30066
DOE/PC/30236-				
T2	NTIS MF A01; 2 (GPO Dep.)	E 1.99: DE85008527	MN -90d	10:29622
DOE/PC/30283-				
T5	NTIS, PC A20/MF A01; 1 (GPO Dep.)	E 1.99: DE85008518	STD -90b	10:29722
DOE/PC/40009-				
T8	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE85012307	STD -90d	10:29623
DOE/PC/40091-				
T15	NTIS, PC A20/MF A01; 1 (GPO Dep.)	E 1.99: DE85013583	STD -90d	10:29624
DOE/PC/40778-				
T4	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99: DE85012500	MN -90d	10:29625
DOE/PC/40786-				
6	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE85013001	MN -90c	10:29626
7	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99: DE85013000	MN -90c	10:29627
DOE/PC/40792-				
T7	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99: DE85013003	MN -90c	10:29628
DOE/PC/40810-				
11	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85009619	MN -90d	10:29654
DOE/PC/50033-				
T3	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85013013	MN -90d	10:29629
T4	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85013014	MN -90d	10:29630
DOE/PC/50053-				
T5	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE85004239	MN -90d	10:29631

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DOE/PC/50270-				
T6	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85012301	MN -90b	10:29713
DOE/PC/50798-				
T5	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85011914	MN -90c	10:29632
T6	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012844	MN -90c	10:29633
DOE/PC/50799-				
T7	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85010075	MN -90d	10:29634
DOE/PC/50801-				
10	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85012351	MN -90a	10:29655
DOE/PC/50804-				
9	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85013791	MN -90a	10:30067
DOE/PC/50807-				
T9	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85010144	MN -90a	10:29656
DOE/PC/50810-				
T10	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE85011001	MN -90a	10:30068
DOE/PC/60039-				
5	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012001	MN -90d	10:29635
DOE/PC/60270-				
T1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE85004132	STD -90i	10:29669
T2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85005215	MN -90i	10:29670
DOE/PC/60785-				
7	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE85012329	MN -90d	10:29657
DOE/PC/60789-				
2	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012350	MN -90b	10:29714
DOE/PC/60807-				
7	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85012539	MN -90a	10:29790
DOE/PC/60809-				
T4	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85012800	MN -90a	10:29723
DOE/PC/60813-				
7	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012302	MN -90a	10:29636
DOE/PC/70006-				
T2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85011199	MN -90d	10:29658
DOE/PC/70723-				
T2	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85011920	MN -90	10:30644
DOE/PC/70764-				
2-Pt.2	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE85012330	MN -90a	10:29724
DOE/PC/70776-				
T3	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85013149	MN -90a	10:29659
DOE/PC/70786-				
T2	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85011491	MN -90d	10:29637
DOE/PC/70796-				
3	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85010822	MN -90a	10:29715
DOE/PC/70811-				
2	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85013247	MN -90d	10:29638
DOE/PC/71253-				
2	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012858	MN -90i	10:32136
DOE/PE-				
0072	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99: DE85013023	STD -41	10:32297
0073	NTIS, PC A10/MF A01 (GPO Dep.)	E 1.99: DE85012362	MN -90j	10:29736
DOE/PE/17056-				
T3	NTIS, PC A05/MF A01 (GPO Dep.)	E 1.99: DE85013245	MN -41	10:32378
DOE/PETC/TR-				
85/ 7	NTIS, PC A06/MF A01 (GPO Dep.)	E 1.99: DE85013006	STD -90i	10:29671
85/ 8	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99: DE85013005	STD -90d	10:29639
DOE/PN/00292-				
T5	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99: DE85011534	MN -11	10:30828
DOE/R0/00047-				
T1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85013420	MN -59B	10:30370
DOE/R0/00451-				
T1	NTIS, PC A05; 3	DE85011336	MN -60	10:30622
DOE/R1/21267-				
T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85013406	MN -95f	10:31354
DOE/R1/23278-				
T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85013350	MN -60	10:30623
DOE/R2/05003-				
T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85012216	MN -61E	10:30069
DOE/R2/05151-				
T1	NTIS MF A01; 2 (GPO Dep.)	E 1.99: DE85013418	MN -95f	10:31355
DOE/R2/05175-				
T1	NTIS, PC A08/MF A01 (GPO Dep.)	E 1.99: DE85013340	MN -59A	10:30545
DOE/R3/02456-				
T1	NTIS MF A01; 2 (GPO Dep.)	E 1.99: DE85009329	MN -61	10:30070
DOE/R3/06108-				
T1	NTIS, PC A10/MF A01; 1 (GPO Dep.)	E 1.99: DE85008467	MN -95f	10:31356
DOE/R3/06112-				
T1	NTIS, PC A04; 3	DE85008993	MN -60	10:30624
DOE/R8/00434-				
T1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85011343	MN -97e	10:30107
DOE/R8/00437-				
T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85011342	MN -59B	10:31263
DOE/R8/00448-				
T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85011337	MN -59A	10:30371
DOE/R8/05032-				
T1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85013335	MN -90	10:29647

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DOE/R8/06041-				
T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85011323	MN -59A	10:30372
DOE/R9/50014-				
T1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE85012215	MN -59B	10:30373
DOE/RA/50219-				
T4	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE85011992	MN -97	10:32372
DOE/RA/50223-				
T1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85011239	MN -97	10:31161
DOE/RG/10241-				
T1	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99: DE85010815	MN -98E	10:31162
DOE/RG/10406-				
T4	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99: DE85012435	MN -98E	10:31163
T5	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99: DE85012436	MN -98E	10:31164
T6	NTIS, PC A07/MF A01 (GPO Dep.)	E 1.99: DE85012437	MN -98E	10:31165
T7	NTIS, PC A08/MF A01; 1 (GPO Dep.)	E 1.99: DE85012438	MN -98E	10:31166
T9	NTIS, PC A08/MF A01; 1 (GPO Dep.)	E 1.99: DE85012439	MN -98E	10:31167
DOE/RL/01830-				
T35	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85011996	MN -4	10:31671
DOE/RW-				
0022	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE85013153	STD -70	10:29918
0023	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE85013154	STD -70	10:29919
DOE/S-				
0035	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE85013255	MN -78	10:31135
DOE/SF/01424-				
T7	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85011201	MN -92a	10:29753
DOE/SF/01948-				
T1	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99: DE85013407	MN -61E	10:31374
DOE/SF/01985-				
T1	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99: DE85012218	MN -61E	10:30071
DOE/SF/10581-				
T1	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE85013401	MN -95f	10:31357
DOE/SF/11629-				
T1	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE85013336	MN -95d	10:31264
DOE/SF/11919-				
T2	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE85012009	MN -59A	10:30374
DOE/SF/12196-				
9	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE85011962	MN -66a	10:30579
DOE/SF/12200-				
T1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE85013587	MN -62c	10:30302
DOE/TIC-				
3386-Suppl.1	NTIS$36.75/MF A01 (GPO Dep.)	E 1.99: DE85008721	STD -32	10:33089
DOE-tr-				
273-Vol.1	NTIS, PC A19/MF A01; 1			10:30657
273-Vol.1	NTIS, PC A19/MF A01; 1			10:31182
273-Vol.1	NTIS, PC A19/MF A01; 1			10:31183
273-Vol.1	NTIS, PC A19/MF A01; 1			10:31184
273-Vol.1	NTIS, PC A19/MF A01; 1			10:31185
DOT-I-				
84-29	GPO*	TI85901496	MN -95d	10:31265
DOT-TSC-UMTA-				
84-29	*See* PB-85-159838/XAB			10:31348
DP-MS-				
76-64	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE85012563	MN -11	10:32113
84-129	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85011507	MN -20	10:32994
84-140	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012323	MN -70	10:29920
84-141	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85010067	MN -70	10:29921
85-9	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE85012328	MN -70B	10:29922
85-11	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85012324	MN -70	10:29923
85-29	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85010068	MN -70	10:31560
85-31	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85011508	MN -46	10:31737
85-57	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012326	MN -4	10:29893
DPh-N-S-				
2181	*See* CEA-CONF-7380	DE85751302	MN -34C	10:32755
2195	*See* CEA-CONF-7403	DE85751335	MN -34C	10:32695
DPST-				
85-1-3	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85011047	MN -2	10:33071
85-273	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012322	MN -4	10:31595
DREO-TN-				
83-33	*See* AD-A-152087/3/XAB			10:29774
DSIR-GC-				
NEW5	*See* INS-R-308	DE85701460	MN -51	10:32395
DTH-LET-RE-				
83-5	NTIS (US Sales Only), PC A11/MF A01; 1	DE85750805	MN -95	10:31833
84-1	NTIS (US Sales Only), PC A10/MF A01; 1	DE85750797	MN -94a	10:31048
84-3	NTIS (US Sales Only), PC A04/MF A01; 1	DE85750809	MN -95e	10:31358
DTH-LV-				
121	NTIS (US Sales Only), PC A04/MF A01	DE85750810	MN -95d	10:31266
156	NTIS (US Sales Only), PC A02/MF A01; 1	DE85750801	MN -95d	10:31267
159	NTIS (US Sales Only), PC A02/MF A01; 1	DE85750800	MN -95d	10:31268
160	NTIS (US Sales Only), PC A02/MF A01; 1	DE85750802	MN -95d	10:31269
161	NTIS (US Sales Only), PC A02/MF A01; 1	DE85750803	MN -95d	10:32343
DTH-LV-MEDD-				
162	NTIS (US Sales Only), PC A13/MF A01; 1	DE85750804	MN -62	10:30562

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E-				
2394	*See* N-85-15878			10:31535
ECRC/M-				
1871	*See* PB-85-158897/XAB			10:31362
EFI-				
675(65) -83	NTIS (US Sales Only), PC A02/MF A01	DE85701005	MN -34D	10:32593
EFN-				
10	NTIS (US Sales Only), PC A09/MF A01	DE85750835	MN -98	10:31139
EFN-LET-				
1983-02	NTIS (US Sales Only), PC A03/MF A01; 1	DE85750829	MN -64	10:30609
EFP-TR-				
31-1983	*See* SLU-ESO-TR-31-1983	DE85750841	MN -61	10:31635
EGG-				
1183-2356-Pts.1-2	NTIS, PC A05/MF A01 (GPO Dep.)	E 1.99: DE85011766	MN -11	10:32180
2164-Rev.3	*See* NUREG/CR-2531-Rev.3	TI85011271	MN -78	10:31006
2323	*See* NUREG/CR-3862	TI85013441	MN -78	10:31012
2341	*See* NUREG/CR-3977	TI85012870	MN -78	10:31014
2382	*See* NUREG/CR-4196	TI85012991	MN -78	10:31025
2383	*See* NUREG/CR-4203	TI85012601	MN -41	10:30031
2393	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE85012415	STD -20e	10:32995
2394-Vol.1	*See* NUREG/CR-4262-Vol.1	TI85013358	MN -78	10:31030
2394-Vol.2	*See* NUREG/CR-4262-Vol.2	TI85013359	MN -78	10:31031
10282-2054	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85011684	MN -25	10:32023
EGG-EA-				
6735	NTIS, PC A02/MF A01 - GPO	TI85011675	MN -78	10:30757
6848	NTIS, PC A02/MF A01 - GPO	TI85012318	MN -78	10:30758
EGG-ED-				
6725-Rev.1	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE85011953	MN -96	10:31426
EGG-ELS-				
6845	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99: DE85011677	MN -66a	10:30600
EGG-M-				
07585	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85012611	MN -80	10:30861
11485	NTIS, PC A02	DE85012615	MN -78	10:30862
13085	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85012331	MN -95f	10:31359
EGG-PBS-				
6851	NTIS, PC A02/MF A01 - GPO	TI85011678	MN -70	10:29924
EGG-RST-				
6860	NTIS, PC A02/MF A01	TI85012472	MN -78	10:30676
EGG-SE-				
6764	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE85011954	MN -96	10:31425
EGG-TMI-				
6859	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE85012613	MN -78	10:30863
EML-				
440	NTIS, PC A05; 3	DE85012570	STD -11	10:32157
ENPU-				
81-10	NTIS (US Sales Only), PC A03/MF A01	DE85701042	MN -51	10:32401
82-2	NTIS (US Sales Only), PC A03/MF A01	DE85701045	MN -51	10:32386
82-10	NTIS (US Sales Only), PC A03/MF A01	DE85701043	MN -51	10:32402
82-16	NTIS (US Sales Only), PC A02/MF A01	DE85701044	MN -51	10:32387
EPA-				
440/ 1-84/ 007	*See* PB-85-156446/XAB			10:32201
450/ 3-84/ 014	*See* PB-85-153906/XAB			10:32142
600/ D-85/ 017	*See* PB-85-157386/XAB			10:32145
600/ D-85/ 042	*See* PB-85-169605/XAB			10:32146
EPA/450/4-				
84/ 014A	*See* PB-85-172336/XAB			10:32147
EPRI-AP-				
4026	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI85920655	ND -90d	10:29640
4030	NTIS, PC A08/MF A01; 1 - Research Reports Center, Box 50490, Palo Alto, CA 94303 (GPO Dep.)	E 1.99: DE85012872	MN -90d	10:29641
4060-Vol.1	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI85920159	ND -60	10:30625
4060-Vol.2	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI85920198	ND -60	10:30626
EPRI-CS-				
3844	Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303	TI85920622	ND -97d	10:30645
3999-CCM-Vol.1	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI85920598	ND -97d	10:30646
3999-CCM-Vol.2	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI85920645	ND -97d	10:30647
4014	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI85920636	ND -90	10:30648
EPRI-EA-				
3898	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI85920668	ND -11	10:32373
3934	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI85920633	ND -97b	10:31168
3994	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI85920591	ND -97b	10:31169
EPRI-EL-				
3918	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI85920603	ND -97a	10:30649

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3972	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI85920651	ND -97a	10:32111
3974	Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303	TI85920608	ND -97a	10:30664
3977-Vol.1	Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303	TI85920602	ND -97a	10:30665
3983	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI85920642	ND -97a	10:30643
3984	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI85920662	ND -97a	10:32051
EPRI-EM-				
3872	Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303, $16.00	TI85920552	ND -94ca	10:31103
EPRI-NP-				
3789	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI85920612	ND -78	10:30691
3821-SR	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI85920658	ND -78	10:31795
3838	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI85920659	ND -78	10:30864
3975	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI85920616	ND -78	10:30917
4010	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI85920653	ND -78	10:30677
4032	Research Reports Center, Box 509490, Palo Alto, CA 94303	TI85920656	ND -78	10:30678
4033	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI85920657	ND -80	10:30918
4043	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI85920654	ND -78	10:30919
4056	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI85920660	ND -80	10:30650
4074M	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI85920661	ND -80	10:30651
ERC-				
07-84	*See* PB-85-157675/XAB			10:30655
ERG-MR-				
1e	Energy Research Group, P.O. Box 8500, Ottawa K1G 3H9, Canada	TI85901446	ND -05	10:31154
2e	Energy Research Group, P.O. Box 8500, Ottawa K1G 3H9, Canada	TI85901445	ND -05	10:31140
3e	Energy Research Group, P.O. Box 8500, Ottawa K1G 3H9, Canada	TI85901444	ND -05	10:31179
4e	Energy Research Group, P.O. Box 8500, Ottawa K1G 3H9, Canada	TI85901443	ND -05	10:30082
5e	Energy Research Group, Box 8500, Ottawa, Canada	TI85901442	ND -05	10:31180
EUR-				
6537	NTIS (US Sales Only), PC A03/MF A01	DE85701522	MN -32	10:30920
6538	NTIS (US Sales Only), PC A03/MF A01	DE85701493	MN -78	10:30921
8484	NTIS (US Sales Only), PC A03/MF A01	DE85701487	MN -25	10:31796
8669	NTIS (US Sales Only), PC A23/MF A01	DE85701517	MN -70	10:29926
8920-Pt.1	NTIS (US Sales Only), PC A07/MF A01	DE85701491	MN -78	10:30922
8920-Pt.2	NTIS (US Sales Only), PC A04/MF A01	DE85701492	MN -78	10:30923
8955	NTIS (US Sales Only), PC A08/MF A01	DE85701489	MN -80	10:30924
9041-EN	*See* PB-85-157527/XAB			10:30630
9043	NTIS (US Sales Only), PC A05/MF A01	DE85701523	MN -32	10:30925
9045-EN	European Community Information Service, 2100 M St., NW, Suite 707, Washington, DC 20037			10:29660
9071	NTIS (US Sales Only), PC A09/MF A01	DE85701264	MN -70	10:29927
9101	NTIS (US Sales Only), PC A04/MF A01	DE85701474	MN -41	10:30926
9106	NTIS (US Sales Only), PC A04/MF A01	DE85701518	MN -70	10:29928
9133	NTIS (US Sales Only), PC A04/MF A01	DE85701485	MN -71	10:29897
9139-EN	*See* PB-85-158962/XAB			10:31281
9147-EN	*See* PB-85-160067/XAB			10:30294
9157-EN	*See* PB-85-157501/XAB			10:30401
9172	NTIS (US Sales Only), PC A07/MF A01	DE85701502	MN -79	10:30927
9181	NTIS (US Sales Only), PC A03/MF A01	DE85701521	MN -16	10:30033
9195	NTIS (US Sales Only), PC A07/MF A01	DE85701486	MN -71	10:29898
9203	NTIS (US Sales Only), PC A09/MF A01	DE85701503	MN -79	10:30928
9226-FR	Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities		ND -25	10:31553
9271-DE	Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities		ND -95e	10:30652
F-				
8324	*See* PB-85-180396/XAB			10:32380
8324-APP	*See* PB-85-180404/XAB			10:32381
FCR-				
6846	NTIS, PC A11/MF A01; 1 (GPO Dep.)	E 1.99: DE85012502	STD -97d	10:30653
FE-				
2315-115	*See* DOE/ET/10532-T23	E 1.99: DE85012359	STD -90d	10:29735
3159-1-80	*See* DOE/ET/13381-T3	E 1.99: DE85002197	MN -90a	10:29648

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FEI-					
1385	NTIS (US Sales Only), PC A02/MF A01		DE85701025	MN -34C	10:32718
1404	NTIS (US Sales Only), PC A02/MF A01		DE85701018	MN -34C	10:32750
1445	NTIS (US Sales Only), PC A02/MF A01		DE85701013	MN -46	10:32800
1474	NTIS (US Sales Only), PC A02/MF A01		DE85701014	MN -46	10:32801
FES-					
74-30	NTIS, PC A10/MF A01; 1		DE85014193	MN -11	10:32208
FFA-TN-					
1983-22	*See* NE-VIND-83-22		DE85750828	MN -60	10:30629
FIAS-R-					
131	NTIS (US Sales Only), PC A03/MF A01		DE85700986	MN -34A	10:32486
FNAL-					
85/ 32	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE85012743	MN -41	10:32173
FNAL/C-					
85/ 59	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE85012296	MN -28	10:31835
85/ 63	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE85012297	MN -28	10:31894
FNAL-TM-					
1307	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85013027	STD -28	10:31942
FRCEA-R-					
15	NTIS (US Sales Only), PC A02/MF A01		DE85751596	MN -62	10:30546
FRN-R-					
82-17	NTIS (US Sales Only), PC A03/MF A01		DE85750833	MN -13	10:31181
FRNC-TH-					
1551	NTIS (US Sales Only), PC A09/MF A01		DE85751298	MN -2	10:33112
1612	NTIS (US Sales Only), PC A07; 3		DE85751346	MN -94a	10:31049
1620	NTIS (US Sales Only), PC A08; 3		DE85751351	MN -61D	10:30072
1631	NTIS (US Sales Only), PC A08; 3		DE85751350	MN -62	10:30547
1752	NTIS (US Sales Only), PC A07; 3		DE85751226	MN -61E	10:30077
1753	NTIS (US Sales Only), PC A04; 3		DE85751227	MN -61E	10:30078
1871	NTIS (US Sales Only), PC A02/MF A01		DE85751222	MN -61	10:30079
1880	NTIS (US Sales Only), PC A07/MF A01		DE85751584	MN -63	10:30303
1882	NTIS (US Sales Only), PC A09/MF A01		DE85751590	MN -95d	10:31270
1883	NTIS (US Sales Only), PC A08/MF A01		DE85751589	MN -59A	10:30375
1884	NTIS (US Sales Only), PC A06/MF A01		DE85751585	MN -63	10:30304
1885	NTIS (US Sales Only), PC A05/MF A01		DE85751591	MN -59A	10:30376
1886	NTIS (US Sales Only), PC A02/MF A01		DE85751588	MN -59B	10:30377
1887	NTIS (US Sales Only), PC A09/MF A01		DE85751581	MN -62	10:30348
1888	NTIS (US Sales Only), PC A07/MF A01		DE85751587	MN -59B	10:30378
1893	NTIS (US Sales Only), PC A08/MF A01		DE85751319	MN -25	10:31561
1898	NTIS (US Sales Only), PC A13/MF A01		DE85751223	MN -61	10:30073
1900	NTIS (US Sales Only), PC A02/MF A01		DE85751224	MN -61	10:30083
1902	NTIS (US Sales Only), PC A09/MF A01		DE85751582	MN -59A	10:30379
1913	NTIS (US Sales Only), PC A08/MF A01		DE85751347	MN -58	10:30276
1914	NTIS (US Sales Only), PC A14/MF A01		DE85751586	MN -60	10:30627
1915	NTIS (US Sales Only), PC A04/MF A01		DE85751583	MN -62	10:30563
1918	NTIS (US Sales Only), PC A05/MF A01		DE85751343	MN -34A	10:32487
1969	NTIS (US Sales Only), PC A16/MF A01; 1		DE85751592	MN -61	10:30074
GA-A-					
17773	NTIS, PC A11/MF A01; 1 (GPO Dep.)	E 1.99:	DE85012311	MN -80	10:30752
GANIL-P-					
84-09	NTIS (US Sales Only), PC A02/MF A01		DE85751339	MN -34C	10:32740
84-10	NTIS (US Sales Only), PC A02/MF A01		DE85751329	MN -28	10:31943
84-11	NTIS (US Sales Only), PC A02/MF A01		DE85751330	MN -34C	10:32680
84-13	NTIS (US Sales Only), PC A02/MF A01		DE85751340	MN -34C	10:32710
84-16	NTIS (US Sales Only), PC A02/MF A01		DE85751341	MN -34C	10:32681
GAO/RCED-					
85-25	General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877		TI85901574	MN -13	10:33072
85-41	US General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20760		TI85901452	MN -11	10:31111
85-88	US General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877		TI85901570	MN -92	10:29788
85-111	US General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877		TI85901572	MN -92	10:29801
GAT-A-					
258	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE85012815	MN -41	10:30026
GAT-E-					
279	NTIS, PC A08/MF A01; 1 (GPO Dep.)	E 1.99:	DE85012823	MN -47	10:29884
GAT-NM-					
119	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85013128	MN -16	10:30034
GAT-S-					
32	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE85012803	MN -11	10:32182
33	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE85012804	MN -11	10:29929
GAT-T-					
3297	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85012796	MN -41	10:30027
3334	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE85012797	MN -22	10:29885
GEAP-					
30846	*See* DOE/ET/34031-18	E 1.99:	DE85009056	STD -78	10:30672
GKSS-					
84/ E/ 47	NTIS (US Sales Only), PC A02/MF A01		DE85751617	MN -25	10:31447
GRS-A-					
945	*See* BMI-1984-056		DE85751652	MN -78	10:30840
1020	*See* BMI-1984-064		DE85751624	MN -78	10:30842

Report Number	*Availability Source*	*File Number*	*Distribution Category*	*Abstract Number*
GRS-F-				
139	NTIS (US Sales Only), PC A25/MF A01	DE85751618	MN -48	10:32820
GSCAN-P-				
84-1A	NTIS (US Sales Only), PC A99/MF A01	DE85780943	MN -51	10:33076
GSF-A-				
1/ 84	NTIS (US Sales Only), PC A06/MF A01; 1	DE85752003	MN -48	10:32350
GSF-BPT-				
6/ 84	NTIS (US Sales Only), PC A03/MF A01; 1	DE85752001	MN -11	10:32137
9/ 84	NTIS (US Sales Only), PC A04/MF A01	DE85752004	MN -11	10:32138
GSF-S-				
1063	NTIS (US Sales Only), PC A03/MF A01	DE85751648	MN -41	10:32298
GSI-				
84-17	NTIS (US Sales Only), PC A07/MF A01	DE85751124	MN -21	10:31944
84-60-Prepr.	NTIS (US Sales Only), PC A02/MF A01	DE85751122	MN -34A	10:32488
84-64-Prepr.	NTIS (US Sales Only), PC A03/MF A01	DE85780952	MN -34A	10:32489
84-65-Prepr.	NTIS (US Sales Only), PC A02/MF A01	DE85780953	MN -34A	10:32490
84-66-Prepr.	NTIS (US Sales Only), PC A02/MF A01	DE85780957	MN -34C	10:32757
84-69-Prepr.	NTIS (US Sales Only), PC A03/MF A01	DE85751125	MN -34C	10:32758
84-70-Prepr.	NTIS (US Sales Only), PC A03/MF A01	DE85751126	MN -34C	10:32759
85-2-Prepr.	NTIS (US Sales Only), PC A03/MF A01	DE85751616	MN -34C	10:32735
85-3-Prepr.	NTIS (US Sales Only), PC A02/MF A01	DE85751649	MN -34C	10:32741
HEDL-				
7540	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99: DE85013265	MN -85	10:29930
HEDL-TME-				
84-29	NTIS, PC A15/MF A01 (GPO Dep.)	E 1.99: DE85013252	STD -20d	10:32996
HMI-B-				
353-Vol.3-Ed.2	NTIS (US Sales Only), PC A99/MF A01	DE85780967	MN -37	10:32049
HSE-Trans-				
7253	*See* SMRE-Trans-7253	DE85901522	MN -88	10:29710
7255	*See* SMRE-Trans-7255	DE85901524	MN -88	10:29711
HTL-				
29	*See* AD-A-150530/4/XAB			10:31824
IA-				
134/ 85	*See* OEFZS-4306	DE85701481	MN -23	10:32061
1404	NTIS (US Sales Only), PC A13/MF A01	DE85780940	MN -25	10:33073
IAE-				
3774/ 11	NTIS (US Sales Only), PC A03/MF A01	DE85701035	MN -25	10:31457
3790/ 2	NTIS (US Sales Only), PC A04/MF A01	DE85701024	MN -34C	10:32701
3815/ 10	NTIS (US Sales Only), PC A02/MF A01	DE85701033	MN -25	10:31458
IAEA-CN-				
44/ D-I-5	*See* IPF-84-9	DE85780959	MN -20d	10:33006
44/ D-III-6-3	*See* IPF-84-10	DE85780958	MN -20f	10:32897
IAEA-R-				
2907-F	NTIS (US Sales Only), PC A03/MF A01	DE85701251	MN -37	10:32024
IAEA-TC-				
427/ 5	NTIS (US Sales Only), PC A14/MF A01	DE85781016	MN -78	10:30681
IAEA-TECDOC-				
301	NTIS (US Sales Only), PC A12/MF A01	DE85701047	MN -11	10:32194
316	NTIS (US Sales Only), PC A03/MF A01	DE85701283	MN -16	10:30035
317	NTIS (US Sales Only), PC A10/MF A01	DE85701252	MN -37	10:32263
319	NTIS (US Sales Only), PC A05/MF A01	DE85701046	MN -51	10:29932
323	NTIS (US Sales Only), PC A10/MF A01	DE85780941	MN -48	10:31597
IC-				
84/ 20	NTIS (US Sales Only), PC A02/MF A01	DE85701285	MN -32	10:30777
84/ 33	NTIS (US Sales Only), PC A03/MF A01	DE85701229	MN -34B	10:30277
IFIN-RB-				
5-1981	NTIS (US Sales Only), PC A02/MF A01	DE85701238	MN -23	10:32183
IFP-				
32-035	NTIS (US Sales Only), PC A09/MF A01; 1	DE85751219	MN -92	10:29661
IFSR-				
177	*See* DOE/ET/53088-177	E 1.99: DE85013122	MN -20g	10:32888
179	*See* DOE/ET/53088-179	E 1.99: DE85013124	MN -20g	10:32889
187	*See* DOE/ET/53088-187	E 1.99: DE85013120	MN -20g	10:32890
190	*See* DOE/ET/53088-190	E 1.99: DE85013121	MN -20a	10:32891
IFT-P-				
01/ 83	NTIS (US Sales Only), PC A02/MF A01	DE85701116	MN -32	10:33090
01/ 84	NTIS (US Sales Only), PC A02/MF A01	DE85701009	MN -34D	10:32594
02/ 84	NTIS (US Sales Only), PC A03/MF A01	DE85700971	MN -34D	10:32853
03/ 83	NTIS (US Sales Only), PC A02/MF A01	DE85701000	MN -34B	10:32420
04/ 84	NTIS (US Sales Only), PC A03/MF A01	DE85700979	MN -34D	10:32854
06/ 83	NTIS (US Sales Only), PC A02/MF A01	DE85700987	MN -34A	10:32537
07/ 83	NTIS (US Sales Only), PC A02/MF A01	DE85701117	MN -32	10:32879
08/ 83	NTIS (US Sales Only), PC A03/MF A01	DE85700972	MN -34D	10:32855
10/ 83	NTIS (US Sales Only), PC A03/MF A01	DE85700984	MN -34D	10:32623
11/ 83	NTIS (US Sales Only), PC A03/MF A01	DE85700973	MN -34D	10:32856
IFVE-OEA-				
83-162	NTIS (US Sales Only), PC A02/MF A01	DE85701286	MN -32	10:33091
IFVE-OEA-OKU-				
83-183	NTIS (US Sales Only), PC A02/MF A01	DE85701065	MN -28	10:31945
IFVE-OEF-				
83-203	NTIS (US Sales Only), PC A02/MF A01	DE85701011	MN -34D	10:32560
IFVE-OEIPK-				
83-108	NTIS (US Sales Only), PC A04/MF A01	DE85701012	MN -34D	10:32561

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IFVE-OTF-OEF-				
83-148	NTIS (US Sales Only), PC A02/MF A01	DE85700663	MN -34D	10:32595
IFVE-OUNK-				
83-120	NTIS (US Sales Only), PC A02/MF A01	DE85701059	MN -28	10:31836
IKE-				
2-67	NTIS (US Sales Only), PC A10/MF A01	DE85751143	MN -78	10:30949
6-149	NTIS (US Sales Only), PC A10/MF A01	DE85751620	MN -78	10:30698
IKMz-				
84-1	NTIS (US Sales Only), PC A09/MF A01	DE85751619	MN -4	10:31708
IMG-TNO-D-				
82	Nijverheidsorganisatie TNO, Delft (Netherlands). Instituut voor Milieuhygiene en Gezondheidstechniek			10:29686
INDC(JPN)-				
97/ G	*See* NEANDC(J)-111/A	TI85901538	ND -34C	10:32803
INDC(NDS)-				
128/ GR	NTIS (US Sales Only), PC A02/MF A01	DE85701036	MN -25	10:31459
INFO-				
0070	NTIS (US Sales Only), PC A03/MF A01	DE85701225	MN -11	10:29933
0070-App.	NTIS (US Sales Only), PC A14/MF A01	DE85701226	MN -11	10:29934
0080	NTIS (US Sales Only), PC A02/MF A01	DE85701281	MN -2	10:30727
0081	NTIS (US Sales Only), PC A15/MF A01	DE85701050	MN -48	10:32309
0083	NTIS (US Sales Only), PC A02/MF A01	DE85701282	MN -2	10:30759
0089	NTIS (US Sales Only), PC A02/MF A01	DE85701234	MN -41	10:30950
0093	NTIS (US Sales Only), PC A04/MF A01	DE85701236	MN -41	10:32310
0115	NTIS (US Sales Only), PC A09/MF A01	DE85701246	MN -80	10:30951
INIEX-FOL-				
6074	INIEX, Liege, Belgium			10:29696
6173	INIEX, Liege, Belgium			10:29689
6368	INIEX, Liege, Belgium			10:29690
6377	INIEX, Liege, Belgium			10:29697
6378	INIEX, Liege, Belgium			10:29698
6379	INIEX, Liege, Belgium			10:29699
6380	INIEX, Liege, Belgium			10:29700
INIS-BR-				
251	NTIS (US Sales Only), PC A06/MF A01	DE85701422	MN -34A	10:31566
252	NTIS (US Sales Only), PC A05/MF A01	DE85701440	MN -34D	10:32596
253	NTIS (US Sales Only), PC A06/MF A01	DE85701423	MN -34A	10:31567
254	NTIS (US Sales Only), PC A07/MF A01	DE85701393	MN -34C	10:32857
INIS-mf-				
9238	NTIS (US Sales Only), PC A03/MF A01	DE85780886	MN -34C	10:32742
9294	NTIS (US Sales Only), PC A04/MF A01	DE85780932	MN -25	10:31460
9296	NTIS (US Sales Only), PC A03/MF A01	DE85780927	MN -34C	10:32104
9297	NTIS (US Sales Only), PC A10/MF A01	DE85780929	MN -4	10:30057
9299	NTIS (US Sales Only), PC A10/MF A01	DE85780947	MN -34C	10:32662
9300	NTIS (US Sales Only), PC A13/MF A01	DE85780931	MN -86	10:31609
9302	NTIS (US Sales Only), PC A07/MF A01	DE85780922	MN -34C	10:32771
9303	NTIS (US Sales Only), PC A05/MF A01	DE85780925	MN -34C	10:32668
9305	NTIS (US Sales Only), PC A02/MF A01	DE85780917	MN -34D	10:32858
9310	NTIS (US Sales Only), PC A10/MF A01	DE85780933	MN -48	10:32174
9424	NTIS (US Sales Only), PC A02/MF A01	DE85780936	MN -28	10:30743
9428	NTIS (US Sales Only), PC A03/MF A01	DE85780938	MN -28	10:31837
9429	NTIS (US Sales Only), PC A02/MF A01	DE85780918	MN -20	10:33001
9458	NTIS (US Sales Only), PC A02/MF A01	DE85701028	MN -4	10:31672
9459	NTIS (US Sales Only), PC A06/MF A01	DE85701118	MN -32	10:32802
9477	NTIS (US Sales Only), PC A14/MF A01	DE85780935	MN -48	10:32267
9478	NTIS (US Sales Only), PC A12/MF A01	DE85780934	MN -48	10:32268
9480	NTIS (US Sales Only), PC A05/MF A01	DE85780930	MN -4	10:31709
9502	NTIS (US Sales Only), PC A06/MF A01	DE85780919	MN -34B	10:32421
9574	NTIS (US Sales Only), PC A08/MF A01	DE85701231	MN -48	10:32175
9625	NTIS (US Sales Only), PC A03/MF A01	DE85780928	MN -4	10:31613
9630	NTIS (US Sales Only), PC A04/MF A01	DE85780920	MN -34D	10:32663
9631	NTIS (US Sales Only), PC A08/MF A01	DE85780921	MN -34D	10:32600
9632	NTIS (US Sales Only), PC A02/MF A01	DE85780923	MN -34C	10:32660
9633	NTIS (US Sales Only), PC A06/MF A01	DE85780924	MN -34C	10:32779
9634	NTIS (US Sales Only), PC A06/MF A01	DE85780926	MN -34C	10:32737
9648	NTIS (US Sales Only), PC A02/MF A01	DE85701403	MN -34D	10:32646
9649	NTIS (US Sales Only), PC A03/MF A01	DE85701532	MN -2	10:32833
9650	NTIS (US Sales Only), PC A02/MF A01	DE85780945	MN -41	10:32823
9651	NTIS (US Sales Only), PC A03/MF A01	DE85701533	MN -2	10:32664
INS-M-				
75	NTIS (US Sales Only), PC A04/MF A01	DE85701451	MN -4	10:31614
INS-R-				
305	NTIS (US Sales Only), PC A02/MF A01	DE85701534	MN -2	10:32665
308	NTIS (US Sales Only), PC A02/MF A01	DE85701460	MN -51	10:32395
312	NTIS (US Sales Only), PC A04/MF A01	DE85701520	MN -2	10:29935
315	NTIS (US Sales Only), PC A03/MF A01	DE85701535	MN -2	10:32311
317	NTIS (US Sales Only), PC A02/MF A01	DE85701471	MN -48	10:32195
320	NTIS (US Sales Only), PC A03/MF A01	DE85701464	MN -11	10:32196
IOM-TM-				
85/ 2	*See* DOE/ER/60036-T2-Vol.1	E 1.99: DE85013323	MN -91	10:29813
85/ 3	*See* DOE/ER/60036-T2-Vol.2	E 1.99: DE85013324	MN -91	10:29841
85/ 4	*See* DOE/ER/60036-T2-Vol.3	E 1.99: DE85013325	MN -91	10:29842
IPF-				
83-8	NTIS (US Sales Only), PC A03/MF A01	DE85780964	MN -20d	10:33002

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83-9	NTIS (US Sales Only), PC A02/MF A01	DE85780963	MN -20d	10:33003
84-1	*See* N-85-18775			10:32908
84-2	*See* N-85-18776			10:32909
84-3	*See* N-85-18777			10:32910
84-4	NTIS (US Sales Only), PC A02/MF A01	DE85780962	MN -20g	10:32896
84-5	NTIS (US Sales Only), PC A03/MF A01	DE85780961	MN -20d	10:33004
84-6	NTIS (US Sales Only), PC A03/MF A01	DE85780960	MN -20d	10:33005
84-9	NTIS (US Sales Only), PC A02/MF A01	DE85780959	MN -20d	10:33006
84-10	NTIS (US Sales Only), PC A02/MF A01	DE85780958	MN -20f	10:32897
IPNO-				
83-04	NTIS (US Sales Only), PC A03/MF A01	DE85751324	MN -37	10:32025
IPNO-DRE-				
83-10	NTIS (US Sales Only), PC A02/MF A01	DE85751323	MN -34C	10:32780
83-21	NTIS (US Sales Only), PC A03/MF A01	DE85751328	MN -34C	10:32703
83-24	NTIS (US Sales Only), PC A02/MF A01	DE85751327	MN -34C	10:32747
83-35	NTIS (US Sales Only), PC A02/MF A01	DE85751290	MN -34C	10:32686
84-17	NTIS (US Sales Only), PC A04/MF A01	DE85751322	MN -37	10:32026
IPNO-GEPL-				
83-04	NTIS (US Sales Only), PC A04/MF A01	DE85751296	MN -28	10:31838
83-09	NTIS (US Sales Only), PC A04/MF A01	DE85751325	MN -28	10:31946
IPNO-TH-				
84-3	NTIS (US Sales Only), PC A02/MF A01	DE85751320	MN -34B	10:32422
84-4	NTIS (US Sales Only), PC A02/MF A01	DE85751321	MN -34B	10:32423
84-32	*See* CNRS-CPT-84-P-1608	DE85751291	MN -34D	10:32585
IPP-				
1/ 228	NTIS (US Sales Only), PC A02/MF A01	DE85751545	MN -20f	10:32898
1/ 234	NTIS (US Sales Only), PC A02/MF A01	DE85751653	MN -20e	10:33007
1/ 299	*See* N-85-18777			10:32910
4/ 218	NTIS (US Sales Only), PC A02/MF A01	DE85780965	MN -20d	10:33008
4/ 219	NTIS (US Sales Only), PC A03/MF A01	DE85780956	MN -20a	10:32899
6/ 235	NTIS (US Sales Only), PC A04/MF A01	DE85780951	MN -20f	10:32900
6/ 237	NTIS (US Sales Only), PC A02/MF A01	DE85780966	MN -20g	10:32901
6/ 241	NTIS (US Sales Only), PC A03/MF A01	DE85780949	MN -20f	10:32902
6/ 242	NTIS (US Sales Only), PC A02/MF A01	DE85780950	MN -20f	10:32903
6/ 244	NTIS (US Sales Only), PC A03/MF A01	DE85780954	MN -34C	10:32859
III/ 97	NTIS (US Sales Only), PC A04/MF A01	DE85780955	MN -20d	10:33009
IS-EMRRI-				
19	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99: DE85011356	MN -90	10:29701
20	NTIS, PC A05/MF A01 (GPO Dep.)	E 1.99: DE85011355	MN -13	10:29614
21	NTIS, PC A05/MF A01 (GPO Dep.)	E 1.99: DE85011354	MN -13	10:29615
IS-T-				
1144	NTIS, PC A06/MF A01 (GPO Dep.)	E 1.99: DE85011758	MN -4	10:31673
1159	NTIS, PC A05/MF A01 (GPO Dep.)	E 1.99: DE85012391	MN -25	10:31531
1174	NTIS, PC A06/MF A01 (GPO Dep.)	E 1.99: DE85012255	MN -37	10:32052
1180	NTIS, PC A10/MF A01 (GPO Dep.)	E 1.99: DE85009225	MN -4	10:31674
ISL-CO-				
220/ 84	*See* PB-85-172401/XAB			10:31831
ISN-				
83-65	NTIS (US Sales Only), PC A02/MF A01	DE85751292	MN -34C	10:32781
84-12	NTIS (US Sales Only), PC A02/MF A01	DE85751334	MN -34C	10:32782
84-13	NTIS (US Sales Only), PC A02/MF A01	DE85751304	MN -34C	10:32783
84-14	NTIS (US Sales Only), PC A02/MF A01	DE85751309	MN -34C	10:32784
84-15	NTIS (US Sales Only), PC A02/MF A01	DE85751310	MN -34C	10:32785
84-16	NTIS (US Sales Only), PC A02/MF A01	DE85751311	MN -34C	10:32786
84-17	NTIS (US Sales Only), PC A02/MF A01	DE85751312	MN -34C	10:32787
84-20	NTIS (US Sales Only), PC A03/MF A01	DE85751295	MN -34C	10:32788
84-22	NTIS (US Sales Only), PC A02/MF A01	DE85751307	MN -34C	10:32728
84-23	NTIS (US Sales Only), PC A02/MF A01	DE85751308	MN -34C	10:32729
84-25	NTIS (US Sales Only), PC A02/MF A01	DE85751306	MN -34C	10:32687
84-26	NTIS (US Sales Only), PC A02/MF A01	DE85751294	MN -34C	10:32699
84-27	NTIS (US Sales Only), PC A02/MF A01	DE85751305	MN -34C	10:32704
ITEF-				
168(1983)	NTIS (US Sales Only), PC A03/MF A01	DE85701119	MN -32	10:30825
ITEP-				
70(1983)	NTIS (US Sales Only), PC A02/MF A01	DE85701007	MN -34D	10:32601
169(1983)	NTIS (US Sales Only), PC A02/MF A01	DE85701006	MN -34D	10:32602
ITF-				
83-95-R	NTIS (US Sales Only), PC A02/MF A01	DE85700975	MN -34D	10:32860
83-98-R	NTIS (US Sales Only), PC A02/MF A01	DE85701019	MN -34C	10:32670
83-113-R	NTIS (US Sales Only), PC A02/MF A01	DE85700982	MN -34D	10:32647
83-120-R	NTIS (US Sales Only), PC A02/MF A01	DE85700974	MN -34D	10:32861
83-134-R	NTIS (US Sales Only), PC A02/MF A01	DE85700970	MN -34D	10:32862
IUC-				
1	*See* STEV-TORV-84-9	DE85750867	MN -88	10:29708
IWGFR-				
085-01	*See* UCRL-15682	E 1.99: DE85012877	MN -91	10:29843
JAERI-M-				
83-161	NTIS (US Sales Only), PC A06/MF A01	DE85701051	MN -23	10:32312
83-169	NTIS (US Sales Only), PC A08/MF A01	DE85701120	MN -32	10:30953
83-184	NTIS (US Sales Only), PC A06/MF A01	DE85701121	MN -32	10:31774
83-187	NTIS (US Sales Only), PC A04/MF A01	DE85701122	MN -32	10:30826
83-224	NTIS (US Sales Only), PC A03/MF A01	DE85701031	MN -25	10:31461
83-230	NTIS (US Sales Only), PC A03/MF A01	DE85700997	MN -20	10:33010
83-231	NTIS (US Sales Only), PC A02/MF A01	DE85701037	MN -25	10:31568

Report Number	*Availability Source*	*File Number*	*Distribution Category*	*Abstract Number*
83-233	NTIS (US Sales Only), PC A04/MF A01	DE85701057	MN -41	10:32158
84-005	NTIS (US Sales Only), PC A03/MF A01	DE85700988	MN -34A	10:32493
84-006	NTIS (US Sales Only), PC A03/MF A01	DE85701058	MN -41	10:32159
84-011	NTIS (US Sales Only), PC A03/MF A01	DE85700995	MN -20	10:33011
84-012	NTIS (US Sales Only), PC A02/MF A01	DE85700993	MN -20	10:33012
84-013	NTIS (US Sales Only), PC A04/MF A01	DE85700998	MN -20	10:33013
84-014	NTIS (US Sales Only), PC A03/MF A01	DE85701032	MN -25	10:31462
84-020	NTIS (US Sales Only), PC A03/MF A01	DE85701056	MN -41	10:31738
84-032	NTIS (US Sales Only), PC A07/MF A01	DE85701060	MN -28	10:31839
84-033	NTIS (US Sales Only), PC A03/MF A01	DE85701123	MN -32	10:33092
84-034	NTIS (US Sales Only), PC A04/MF A01	DE85700999	MN -20	10:33014
84-043	NTIS (US Sales Only), PC A03/MF A01	DE85701029	MN -86	10:29936
84-047	NTIS (US Sales Only), PC A03/MF A01	DE85700992	MN -20	10:32904
84-062	NTIS (US Sales Only), PC A04/MF A01	DE85700994	MN -20	10:33015
85-024	*See* NEANDC(J)-111/A	TI85901538	ND -34C	10:32803
JINR-				
1-83-908	NTIS (US Sales Only), PC A02/MF A01	DE85701023	MN -34C	10:32688
1-83-910	NTIS (US Sales Only), PC A02/MF A01	DE85701062	MN -28	10:31895
8-84-165	NTIS (US Sales Only), PC A02/MF A01	DE85701001	MN -34A	10:31739
9-84-129	NTIS (US Sales Only), PC A02/MF A01	DE85701063	MN -28	10:31896
10-83-852	NTIS (US Sales Only), PC A02/MF A01	DE85701124	MN -32	10:33093
11-83-531	NTIS (US Sales Only), PC A02/MF A01	DE85701247	MN -37	10:32053
11-83-875	NTIS (US Sales Only), PC A02/MF A01	DE85700978	MN -34D	10:32863
18-83-915	NTIS (US Sales Only), PC A02/MF A01	DE85701027	MN -4	10:31615
19-83-884	NTIS (US Sales Only), PC A02/MF A01	DE85701049	MN -48	10:32313
E-1-83-850	NTIS (US Sales Only), PC A02/MF A01	DE85701026	MN -34C	10:32730
E-1-83-851	NTIS (US Sales Only), PC A02/MF A01	DE85701022	MN -34C	10:32789
E-2-84-11	NTIS (US Sales Only), PC A02/MF A01	DE85700983	MN -34D	10:32648
E-2-84-12	NTIS (US Sales Only), PC A02/MF A01	DE85701008	MN -34D	10:32603
R-2-83-872	NTIS (US Sales Only), PC A02/MF A01	DE85700976	MN -34D	10:32864
R-2-83-899	NTIS (US Sales Only), PC A02/MF A01	DE85700985	MN -34A	10:32494
R-2-84-78	NTIS (US Sales Only), PC A02/MF A01	DE85701017	MN -34C	10:32790
R-2-84-232	NTIS (US Sales Only), PC A02/MF A01	DE85701003	MN -34D	10:32604
R-4-84-15	NTIS (US Sales Only), PC A02/MF A01	DE85701020	MN -34C	10:32671
R-4-84-100	NTIS (US Sales Only), PC A02/MF A01	DE85700977	MN -34D	10:32865
R-4-84-135	NTIS (US Sales Only), PC A02/MF A01	DE85701016	MN -34C	10:32672
R-6-84-149	NTIS (US Sales Only), PC A02/MF A01	DE85701010	MN -34D	10:32564
R-7-84-68	NTIS (US Sales Only), PC A02/MF A01	DE85701021	MN -34C	10:32731
R-11-83-893	NTIS (US Sales Only), PC A02/MF A01	DE85701061	MN -28	10:31897
R-14-83-855	NTIS (US Sales Only), PC A02/MF A01	DE85701030	MN -25	10:31569
JINR-R-				
9-83-920	NTIS (US Sales Only), PC A02/MF A01	DE85701066	MN -28	10:31947
JPL/D-				
2274	*See* DOE/MC/20417-1825	E 1.99: DE85009891	STD -90c	10:29619
JPL-PUB-				
84-79	*See* DOE/CS/54209-22	E 1.99: DE85008643	STD -96	10:31423
JPL-PUBL-				
84-65	*See* N-85-16294			10:30306
84-71	*See* N-85-16295			10:30307
84-73	*See* N-85-16297			10:30548
JTI-				
53	*See* STEV-EO-84-4	DE85750839	MN -61A	10:30318
Juel-				
1923	NTIS (US Sales Only), PC A06/MF A01	DE85751139	MN -25	10:31463
1939	NTIS (US Sales Only), PC A09/MF A01	DE85751128	MN -25	10:31464
1950	NTIS (US Sales Only), PC A08/MF A01	DE85751650	MN -70	10:30028
1953	NTIS (US Sales Only), PC A07/MF A01	DE85751651	MN -86	10:29937
1960	NTIS (US Sales Only), PC A09/MF A01	DE85751639	MN -34C	10:32791
Juel-Spez-				
256	NTIS (US Sales Only), PC A03/MF A01	DE85751123	MN -16	10:30036
275	NTIS (US Sales Only), PC A03/MF A01	DE85751644	MN -80	10:30954
276	NTIS (US Sales Only), PC A12/MF A01; 1	DE85752000	MN -11	10:32188
279	NTIS (US Sales Only), PC A06/MF A01	DE85752002	MN -11	10:32139
K-Trans-				
299	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85013137	MN -22	10:29888
K/TS-				
11-516	NTIS, PC A09/MF A01 (GPO Dep.)	E 1.99: DE85013096	MN -34	10:32538
KBS-TR-				
121	NTIS (US Sales Only), PC A14/MF A01	DE85701265	MN -70	10:29938
KEK-				
82-14	NTIS (US Sales Only), PC A11/MF A01	DE85781031	MN -28	10:31856
KFK-				
3500	NTIS (US Sales Only), PC A05/MF A01	DE85751133	MN -80	10:30955
3608	NTIS (US Sales Only), PC A07/MF A01	DE85751642	MN -21	10:33017
3779	*See* Juel-1960	DE85751639	MN -34C	10:32791
3782	NTIS (US Sales Only), PC A09/MF A01	DE85780948	MN -48	10:32314
3793	NTIS (US Sales Only), PC A07/MF A01	DE85751131	MN -22	10:29886
3802	NTIS (US Sales Only), PC A05/MF A01	DE85751134	MN -25	10:31465
3819	NTIS (US Sales Only), PC A09/MF A01	DE85751132	MN -25	10:31466
3825	NTIS (US Sales Only), PC A04/MF A01	DE85751646	MN -70B	10:29939
3833	NTIS (US Sales Only), PC A07/MF A01	DE85751654	MN -32	10:33094
3836	NTIS (US Sales Only), PC A04/MF A01	DE85751142	MN -86	10:29895
3843	NTIS (US Sales Only), PC A03/MF A01	DE85751140	MN -86	10:32054
3844	NTIS (US Sales Only), PC A04/MF A01	DE85751141	MN -86	10:32055

Report Number	*Availability Source*	*File Number*	*Distribution Category*	*Abstract Number*
3855	NTIS (US Sales Only), PC A04/MF A01	DE85751645	MN -80	10:33095
3857	NTIS (US Sales Only), PC A02/MF A01	DE85751621	MN -38	10:31740
3858	NTIS (US Sales Only), PC A02/MF A01	DE85751627	MN -37	10:32027
3866	NTIS (US Sales Only), PC A03/MF A01	DE85751622	MN -11	10:32160
3868	NTIS (US Sales Only), PC A02/MF A01	DE85751643	MN -86	10:31616
3875	NTIS (US Sales Only), PC A05/MF A01	DE85751640	MN -20d	10:33018
KFKI-				
1984-81	NTIS (US Sales Only), PC A02/MF A01	DE85701248	MN -37	10:32028
KHM-TR-				
104	NTIS (US Sales Only), PC A08/MF A01; 1	DE85750838	MN -90i	10:29672
KIYI-				
83-12	NTIS (US Sales Only), PC A03/MF A01	DE85781033	MN -34C	10:32666
83-15	NTIS (US Sales Only), PC A03/MF A01	DE85780968	MN -28	10:31860
KMSF-U-				
1539	*See* AD-A-150513/0/XAB			10:33077
KTR-				
83-22	*See* STEV-BF-83-15	DE85750840	MN -90c	10:29642
L-				
15865	*See* N-85-17550			10:32316
LA-				
10307-MS	*See* NUREG/CR-4079	TI85010350	MN -78	10:31017
10351-MS	*See* NUREG/CR-4140	TI85013270	MN -78	10:31021
10367-MS	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85011897	STD -94b	10:31741
10369-MS	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE85011892	STD -70	10:32403
LA-tr-				
85-21	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012483	MN -28	10:31934
85-25	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85013266	MN -34A	10:31888
85-26	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE85013267	MN -80	10:31039
85-27	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE85013189	MN -47	10:31637
LA-UR-				
84-2753	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE84016822	MN -34	10:32082
84-3370	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85002419	MN -32	10:33096
84-3578	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85003755	MN -96	10:32056
85-457	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85007703	MN -78	10:30956
85-558	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85007665	MN -80	10:30957
85-742	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85009587	MN -45	10:32083
85-769	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85009593	MN -45	10:32084
85-828	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85009575	MN -32	10:33097
85-860	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85009581	MN -45	10:32085
85-887	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85009550	MN -59B	10:30380
85-981	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85009634	MN -25	10:31533
85-1023	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85009620	MN -45	10:32086
85-1049	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85009625	MN -34	10:32539
85-1088	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85009598	MN -45	10:32087
85-1122	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85009606	MN -45	10:32088
85-1130	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85009609	MN -45	10:32089
85-1149	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE85010771	MN -38	10:31742
85-1264	NTIS, PC A02/MF A01 - GPO (GPO Dep.)	E 1.99: TI85010710	MN -78	10:30958
85-1352	NTIS, PC A02; 3	DE85012698	MN -28	10:31861
85-1390	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85010750	MN -45	10:32090
85-1436	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85012697	MN -15	10:29887
85-1450	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85010738	MN -34C	10:32673
85-1476	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85010731	MN -34C	10:32029
85-1526	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012693	MN -28	10:31898
85-1528	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012691	MN -28	10:31899
85-1584	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012682	MN -28	10:31977
85-1602	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012674	MN -15	10:29890
85-1605	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012672	MN -28	10:31978
85-1606	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012671	MN -28	10:32496
85-1610	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012667	MN -28	10:31900
85-1611	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012666	MN -28	10:31979
85-1613	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012664	MN -28	10:32006
85-1614	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012663	MN -28	10:31980
85-1615	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012662	MN -28	10:31901
85-1616	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85012661	MN -28	10:32824
85-1617	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012660	MN -28	10:31862
85-1618	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012659	MN -28	10:31863
85-1619	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012658	MN -28	10:31864
85-1620	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012657	MN -28	10:31981
85-1622	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012655	MN -28	10:31902
85-1624	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012653	MN -28	10:31982
85-1640	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012648	MN -28	10:31983
85-1648	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012711	MN -25	10:31467
85-1649	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012710	MN -15	10:30037
85-1654	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012706	MN -28	10:31903
85-1682	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012718	MN -28	10:31904
85-1683	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012717	MN -15	10:30038
85-1684	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012716	MN -15	10:30039
85-1685	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012715	MN -15	10:30040
85-1705	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012714	MN -10	10:30041
85-1728	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012730	MN -92b	10:29804
85-1729	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012729	MN -78	10:30715
85-1730	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012728	MN -80	10:30778
85-1735	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012725	MN -28	10:31984

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85-1736	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012724	MN -28	10:31985
85-1737	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012723	MN -28	10:31986
85-1742	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012750	MN -34B	10:32427
85-1789	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012744	MN -20d	10:32905
85-1792	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012739	MN -20d	10:33019
85-1817	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85012736	MN -32	10:33098
85-1818	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012735	MN -20b	10:33020
85-1936	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85012756	MN -38	10:31805
85-1939	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85012755	MN -38	10:31806
85-1961	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012751	MN -34C	10:32690
LBL-				
6878	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE85012008	MN -11	10:32189
17001	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE85012549	MN -95d	10:31271
17473	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012555	MN -11	10:32389
18268	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85012553	MN -66a	10:30573
18457	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99: DE85009903	MN -38	10:31468
18520	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE85013316	MN -66	10:30574
18705	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99: DE85013185	MN -4	10:31719
18944	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012603	MN -34C	10:32691
19136	NTIS, PC A10/MF A01 (GPO Dep.)	E 1.99: DE85011983	MN -20	10:33021
19146	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99: DE85010628	STD -94c	10:31683
19222	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE85011984	MN -34C	10:32792
19286	NTIS, PC A14/MF A01; 1 (GPO Dep.)	E 1.99: DE85012558	MN -34A	10:31469
19302	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85011164	MN -34D	10:32866
19319	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85010984	MN -37	10:32057
19374	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE85013187	MN -61B	10:30305
19396	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85011207	MN -25	10:31534
19444	NTIS, PC A09/MF A01 (GPO Dep.)	E 1.99: DE85012231	MN -4	10:31675
19452	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012608	MN -25	10:31570
19459	NTIS, PC A08/MF A01 (GPO Dep.)	E 1.99: DE85011975	MN -25	10:31658
19466	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012605	MN -25	10:31571
19500	NTIS, PC A08/MF A01 (GPO Dep.)	E 1.99: DE85011990	MN -48	10:32315
19552	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE85013184	MN -88	10:29704
19583	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012604	MN -4	10:31720
LPA-P-				
1	British Library Lending Division, Boston Spa, Wetherby, LS23 7BQ		ND -78	10:30829
2	British Library Lending Division, Boston Spa, Wetherby, LS23 7BQ		ND -78	10:30716
3	British Library Lending Division, Boston Spa, Wetherby, LS23 7BQ		ND -78	10:30959
5	British Library Lending Division, Boston Spa, Wetherby, LS23 7BQ		ND -78	10:30960
LUTKDH/TKKA-				
7002/ 1-28/ (1982)	NTIS (US Sales Only), PC A03/MF A01; 1	DE85750830	MN -38	10:31828
LUTMDN/TMVK-				
1006-1-32-(1983)	NTIS (US Sales Only), PC A09/MF A01; 1	DE85750846	MN -97b	10:31170
LYCEN-				
8343	NTIS (US Sales Only), PC A05/MF A01	DE85751299	MN -34C	10:32748
8349	NTIS (US Sales Only), PC A05/MF A01	DE85751293	MN -34C	10:32700
8409	NTIS (US Sales Only), PC A05/MF A01	DE85751336	MN -34C	10:32674
8415	NTIS (US Sales Only), PC A02/MF A01	DE85751289	MN -34C	10:32793
M-				
37	*See* N-85-18909			10:32434
MLM-				
3250(OP)	NTIS MF A01; 2 (GPO Dep.)	E 1.99: DE85011281	MN -23	10:30056
3252	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85013321	MN -45	10:32091
3254	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE85013320	STD -11	10:32161
MPE-				
185	*See* N-85-18935			10:32437
MPI-PAE/Exp.El.-				
142	NTIS (US Sales Only), PC A03/MF A01	DE85751136	MN -37	10:32030
MRL-R-				
931	*See* AD-A-150292/1/XAB			10:31754
939	*See* AD-A-151372/0/XAB			10:31757
N-				
85-15878	NTIS, PC A02/MF A01			10:31535
85-15926	British Library Lending Div., Boston Spa, England			10:29809
85-16180	NTIS, PC A09/MF A01			10:31743
85-16292	NTIS, PC A05/MF A01			10:31187
85-16294	NTIS, PC A02/MF A01			10:30306
85-16295	NTIS, PC A03/MF A01			10:30307
85-16297	NTIS, PC A04/MF A01			10:30548
85-16301	NTIS, PC A02/MF A01			10:30628
85-16302	NTIS, PC A05/MF A01			10:30308
85-16319	British Library Lending Div., Boston Spa, England			10:32140
85-16324	NTIS, PC A06/MF A01			10:32141
85-16374	NTIS MF A01			10:30245
85-16375	NTIS MF A01			10:31116
85-16728	NTIS, PC A02/MF A01			10:31905
85-16729	NTIS, PC A03/MF A01			10:32428
85-17047	NTIS, PC A04/MF A01			10:31545
85-17088	NTIS, PC A03/MF A01			10:31721
85-17089	NTIS, PC A04/MF A01			10:31722

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85-17130	NTIS, PC A03/MF A01			10:31104
85-17182	NTIS, PC A03/MF A01			10:31761
85-17364	NTIS, PC A02/MF A01			10:30309
85-17383	SVIC, Code 5804, Naval Research Lab., Washington, DC 20375			10:32396
85-17430	British Library Lending Div., Boston Spa, England			10:31617
85-17451	NTIS, PC A02/MF A01			10:32459
85-17461	NTIS, PC A12/MF A01			10:32460
85-17463	NTIS, PC A12/MF A01			10:32461
85-17468	NTIS, PC A12/MF A01			10:32462
85-17474	NTIS, PC A03/MF A01			10:32112
85-17550	NTIS, PC A03/MF A01			10:32316
85-17763	NTIS, PC A12/MF A01			10:32429
85-17764	NTIS, PC A12/MF A01			10:32430
85-17779	NTIS, PC A12/MF A01			10:32431
85-17820	NTIS, PC A13/MF A01			10:32432
85-17925	NTIS, PC A02/MF A01			10:32463
85-17926	NTIS, PC A02/MF A01			10:32433
85-17928	NTIS, PC A04/MF A01			10:31429
85-18747	NTIS, PC A07/MF A01			10:32906
85-18772	NTIS, PC A03/MF A01			10:32907
85-18775	NTIS, PC A02/MF A01			10:32908
85-18776	NTIS, PC A02/MF A01			10:32909
85-18777	NTIS, PC A08/MF A01			10:32910
85-18909	NTIS, PC A06/MF A01			10:32434
85-18911	NTIS, PC A05/MF A01			10:32435
85-18913	NTIS, PC A02/MF A01			10:32436
85-18935	NTIS, PC A03/MF A01			10:32437
85-18941	NTIS, PC A03/MF A01			10:32438
85-18942	NTIS, PC A02/MF A01			10:32439
85-19823	NTIS, PC A03/MF A01			10:32464
85-19847	NTIS, PC A02/MF A01			10:31572
85-19900	NTIS, PC A03/MF A01			10:32440
85-19901	NTIS, PC A02/MF A01			10:32441
85-19904	NTIS, PC A03/MF A01			10:32442
85-19905	NTIS, PC A02/MF A01			10:32443
85-19912	NTIS, PC A05/MF A01			10:32444
85-19913	NTIS, PC A03/MF A01			10:32445
85-19916	NTIS, PC A02/MF A01			10:32446
NAC-AR-				
84-01	NTIS (US Sales Only), PC A14/MF A01	DE85780939	MN -34A	10:31987
NASA/CR-				
3803	NTIS, PC A04/MF A01	DE85901308	MN -38	10:31829
171293	*See* N-85-17451			10:32459
174257	*See* N-85-16302			10:30308
174259	*See* N-85-16295			10:30307
174265	*See* N-85-16297			10:30548
174270	*See* N-85-16294			10:30306
174314	*See* N-85-17047			10:31545
174331	*See* N-85-17364			10:30309
174351	*See* N-85-19823			10:32464
174354	*See* N-85-19904			10:32442
174370	*See* N-85-19901			10:32441
174378	*See* N-85-18913			10:32436
174410	*See* N-85-19847			10:31572
174414	*See* N-85-19905			10:32443
174415	*See* N-85-19916			10:32446
174433	*See* N-85-19913			10:32445
174801	*See* N-85-16292			10:31187
NASA-TM-				
77292	*See* N-85-16180			10:31743
77779	*See* N-85-16301			10:30628
83739	NTIS, PC A03/MF A01	TI85901299	MN -38	10:31775
86082	*See* N-85-17926			10:32433
86157	*See* N-85-18942			10:32439
86161	*See* N-85-17925			10:32463
86162	*See* N-85-18911			10:32435
86169	*See* N-85-18909			10:32434
86173	*See* N-85-16729			10:32428
86312	*See* N-85-16728			10:31905
86324	*See* N-85-17550			10:32316
86670	*See* N-85-19900			10:32440
86899	*See* N-85-17928			10:31429
86905	*See* N-85-15878			10:31535
86986	*See* DOE/NASA/20320-64	E 1.99: DE85013105	STD -60	10:30621
87416	*See* N-85-19912			10:32444
NBS/SP-				
689	*See* PB-85-178051/XAB			10:31430
NCEL-TN-				
1708	*See* AD-A-150181/6/XAB			10:31371
NE-SBT-				
83-16	NTIS (US Sales Only), PC A03/MF A01; 1	DE85750861	MN -90b	10:29663
NE-VIND-				
83-18	NTIS (US Sales Only), PC A02/MF A01	DE85750827	MN -60	10:30616

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83-22	NTIS (US Sales Only), PC A04/MF A01; 1	DE85750828	MN -60	10:30629
NEANDC(J)-				
111/ A	JAERI, Tokai-mura, Naka-gun, Ibaraki-ken 319-11, Japan	TI85901538	ND -34C	10:32803
NIIEFA-P-B-				
0587	NTIS (US Sales Only), PC A02/MF A01	DE85701064	MN -28	10:31906
NIM-				
1945	NTIS (US Sales Only), PC A10/MF A01	DE85701452	MN -4	10:31633
NIRS-M-				
41	NTIS (US Sales Only), PC A15/MF A01	DE85781032	MN -20	10:33025
NIRS-RSD-				
60	NTIS (US Sales Only), PC A02/MF A01	DE85781034	MN -41	10:32199
NMERDI-				
2-71-4221	NTIS, PC A04/MF A01; 1 - NMERDI Univ. of New Mexico, 457 Washington SE, Albuquerque, NM 87108	DE85901266	MN -66	10:30584
2-72-4618/ 1	NTIS, PC A07/MF A01; 1 - NMERDI, Univ. of New Mexico, 457 Washington SE, Albuquerque, NM 87108	DE85901564	MN -95d	10:31272
2-72-4628	NMERDI, Suite M., 457 Washington SE, Albuquerque, NM 87108	DE85901468	MN -95e	10:29786
2-73-4622	NTIS, PC A06/MF A01; 1 - NMERDI-Univ. of New Mexico, 457 Washington SE, Albuquerque, NM 87108	DE85901566	MN -92a	10:29782
NP-				
4901587	NTIS (US Sales Only), PC A07/MF A01; 1	DE84901587	MN -88	10:29691
5750798	NTIS (US Sales Only), PC A04/MF A01; 1	DE85750798	MN -95d	10:31273
5750799	NTIS (US Sales Only), PC A04/MF A01; 1	DE85750799	MN -13	10:31114
5750806	NTIS (US Sales Only), PC A04/MF A01; 1	DE85750806	MN -13	10:31122
5750808	NTIS (US Sales Only), PC A02/MF A01; 1	DE85750808	MN -97e	10:30105
5750811	NTIS (US Sales Only), PC A11/MF A01; 1	DE85750811	MN -97e	10:30246
5750812	NTIS (US Sales Only), PC A02/MF A01	DE85750812	MN -13	10:31123
5750832	NTIS (US Sales Only), PC A06/MF A01	DE85750832	MN -90	10:29737
5750834	NTIS (US Sales Only), PC A05/MF A01; 1	DE85750834	MN -88	10:29705
5750860	NTIS (US Sales Only), PC A05/MF A01	DE85750860	MN -98	10:31141
5770191	NTIS (US Sales Only), PC A16/MF A01; 1	DE85770191	MN -13	10:30654
5770293	NTIS (US Sales Only), PC A05/MF A01; 1	DE85770293	MN -59A	10:30549
5770294	NTIS (US Sales Only), PC A08/MF A01	DE85770294	MN -94d	10:31051
5770295	NTIS (US Sales Only), PC A10/MF A01; 1	DE85770295	MN -90i	10:29675
5770296	NTIS (US Sales Only), PC A07/MF A01; 1	DE85770296	MN -48	10:32351
5770297	NTIS (US Sales Only), PC A02/MF A01; 1	DE85770297	MN -05	10:31147
5770298	NTIS (US Sales Only), PC A02/MF A01; 1	DE85770298	MN -05	10:31148
5770299	NTIS (US Sales Only), PC A02/MF A01	DE85770299	MN -05	10:31149
5770300	NTIS (US Sales Only), PC A02/MF A01; 1	DE85770300	MN -05	10:31176
5900477	NTIS, PC A02/MF A01; 1	DE85900477	MN -59B	10:30399
5900964	NTIS (US Sales Only), PC A08/MF A01; 1	DE85900964	MN -51	10:29878
5900966	NTIS (US Sales Only), PC A04/MF A01; 1	DE85900966	MN -11	10:32410
5900976	NTIS (US Sales Only), PC A11; 3	DE85900976	MN -59A	10:30550
5900978	NTIS (US Sales Only), PC A02/MF A01	DE85900978	MN -59B	10:30400
5901429	University of Hawaii at Manoa, Honolulu, HI	TI85901429	MN -13	10:31129
5901441	NTIS, PC A02/MF A01	DE85901441	MN -97e	10:30089
5901712	NTIS, PC A02/MF A01	DE85901712	MN -95f	10:31156
NPC(W)R-				
764	NTIS (US Sales Only), PC A03/MF A01	DE85701266	MN -70	10:29940
NRCN-				
515	NTIS (US Sales Only), PC A02/MF A01	DE85701506	MN -37	10:32171
518	NTIS (US Sales Only), PC A04/MF A01	DE85701433	MN -20	10:32911
532	NTIS (US Sales Only), PC A02/MF A01	DE85701453	MN -4	10:31634
536	NTIS (US Sales Only), PC A03/MF A01	DE85701488	MN -80	10:30779
544	NTIS (US Sales Only), PC A02/MF A01	DE85701411	MN -34A	10:32501
NRCN(LS)-				
015	NTIS (US Sales Only), PC A04/MF A01	DE85701458	MN -25	10:31536
NRCN(TN)-				
077	NTIS (US Sales Only), PC A03/MF A01	DE85701509	MN -37	10:32032
NRL-				
1983/ 1	NTIS (US Sales Only), PC A04/MF A01	DE85701476	MN -41	10:32826
1983/ 5	NTIS (US Sales Only), PC A02/MF A01	DE85701478	MN -48	10:32270
1983/ 6	NTIS (US Sales Only), PC A02/MF A01	DE85701477	MN -41	10:32176
NRL-Memo-				
5591	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE85013088	MN -20a	10:33026
NRL-MR-				
5458	*See* AD-A-151392/8/XAB			10:31889
5484	*See* AD-A-150519/7/XAB			10:32980
5490	*See* AD-A-150319/2/XAB			10:31727
5494	*See* AD-A-151414/0/XAB			10:32457
NRPB-R-				
164	HMSO, London, price Pound 4.00		ND -48	10:32271
165	HMSO, London, price Pound 4.00		ND -48	10:32272
168	HMSO, London, price Pound 4.00		ND -41	10:32827
NUCLEBRAS-CDTN-				
456	NTIS (US Sales Only), PC A06/MF A01	DE85701465	MN -34B	10:30830
NUREG-				
0020-Vol.9-No.4	NTIS, PC A19/MF A01 - GPO	TI85901532	MN -80	10:30669
0040-Vol.9-No.1	NTIS, PC A10/MF A01 - GPO	TI85901494	MN -80	10:30760

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0090-Vol.7-No.4	NTIS, PC A03/MF A01 - GPO	TI85901540	MN -80	10:30961
0525-Rev.10	NTIS, PC A04/MF A01 - GPO	TI85901517	MN -15	10:30042
0675-Suppl.31	NTIS, PC A08/MF A01 - GPO	TI85901371	MN -78	10:30962
0748-Vol.5-No.3	NTIS, PC A15/MF A01 - GPO	TI85901504	MN -78	10:30761
0797-Suppl.10	NTIS, PC A15/MF A01 - GPO	TI85900972	MN -78	10:30963
0797-Suppl.11	NTIS, PC A15/MF A01 - GPO	TI85901541	MN -78	10:30964
0857-Suppl.8	NTIS, PC A03/MF A01 - GPO	TI85901545	MN -78	10:30965
0936-Vol.4-No.1	NTIS, PC A09/MF A01 - GPO	TI85901537	MN -2	10:30762
0975-Vol.3	NTIS, PC A17/MF A01 - GPO	TI85901503	MN -78	10:30685
0991-Suppl.4	NTIS, PC A03/MF A01 - GPO	TI85901359	MN -78	10:30966
1032	NTIS, PC A09/MF A01 - GPO	TI85901551	MN -80	10:30967
1033	NTIS, PC A12/MF A01	TI85901475	MN -78	10:30831
1037	NTIS, PC A14/MF A01 - GPO	TI85900970	MN -78	10:30968
1038-Suppl.2	NTIS, PC A04/MF A01 - GPO	TI85901567	MN -78	10:30969
1085	NTIS, PC A16/MF A01 - GPO	TI85901424	MN -78	10:30832
1095	NTIS, PC A05/MF A01 - GPO	TI85901547	MN -78	10:30970
1119	NTIS, PC A04/MF A01 - GPO	TI85901502	MN -80	10:30971
1127	NTIS, PC A03/MF A01 - GPO	TI85901534	MN -41	10:30030
1132	NTIS, PC A20/MF A01 - GPO	TI85901439	MN -78	10:30763
1133	NTIS, PC A22/MF A01 - GPO	TI85901552	MN -78	10:30764
1134	NTIS, PC A04/MF A01 - GPO	TI85901511	MN -41	10:32325
1135	NTIS, PC A05/MF A01 - GPO	TI85901542	MN -80	10:30972
NUREG/CR-				
0200-Vol.1	NTIS, PC A99/MF A01; 1 - GPO	TI85007563	MN -15	10:30780
0200-Vol.2	NTIS, PC A99/MF A01; 1 - GPO	TI85007576	MN -15	10:30785
0200-Vol.3	NTIS, PC A21/MF A01; 1 - GPO	TI85007581	MN -15	10:30796
2000-Vol.4-No.4	NTIS, PC A05/MF A01 - GPO	TI85012784	MN -78	10:31005
2531-Rev.3	NTIS, PC A05/MF A01 - GPO	TI85011271	MN -78	10:31006
2718	NTIS, PC A07/MF A01 - GPO	TI85012600	MN -78	10:31007
3293-Vol.1	NTIS, PC A15/MF A01 - GPO	TI85013021	MN -80	10:31710
3293-Vol.2	NTIS, PC A13/MF A01 - GPO	TI85013022	MN -80	10:31711
3317	NTIS, PC A04/MF A01 - GPO	TI85013318	MN -78	10:31008
3514-Vol.2	NTIS, PC A02/MF A01 - GPO	TI85010139	MN -78	10:31693
3551	NTIS, PC A05/MF A01 - GPO	TI85012807	MN -80	10:31009
3626-Vol.2	NTIS, PC A14/MF A01 - GPO	TI85008300	MN -80	10:30767
3651	NTIS, PC A04/MF A01 - GPO	TI85010620	MN -78	10:31010
3723	NTIS, PC A03/MF A01 - GPO	TI85006633	MN -78	10:30717
3747	NTIS, PC A06/MF A01 - GPO	TI85013799	MN -70A	10:29950
3810-Vol.4	NTIS, PC A03/MF A01 - GPO	TI85012832	MN -80	10:31011
3855-6-84	NTIS, PC A12/MF A01 - GPO	TI85000657	MN -78	10:30813
3862	NTIS PC E14/MF A01 - GPO	TI85013441	MN -78	10:31012
3863	NTIS, PC A09/MF A01 - GPO	TI85012824	MN -78	10:30687
3900-Vol.3	NTIS, PC A05/MF A01 - GPO	TI85901514	MN -70	10:31471
3904	NTIS, PC A06/MF A01 - GPO	TI85013272	MN -80	10:31013
3906	NTIS, PC A04/MF A01 - GPO	TI85013271	MN -70	10:29951
3977	NTIS, PC A11/MF A01 - GPO	TI85012870	MN -78	10:31014
3980-Vol.3	NTIS, PC A03/MF A01 - GPO	TI85011200	MN -78	10:31015
4044	NTIS, PC A05/MF A01 - GPO	TI85013275	MN -78	10:31016
4079	NTIS, PC A05/MF A01 - GPO	TI85010350	MN -78	10:31017
4086	NTIS, PC A02/MF A01 - GPO	TI85009806	MN -80	10:30688
4092	NTIS, PC A08/MF A01 - GPO	TI85011249	MN -78	10:31472
4093	NTIS, PC A11/MF A01 - GPO	TI85012310	MN -78	10:31018
4105	NTIS, PC A04/MF A01	TI85010347	MN -78	10:31019
4106	NTIS, PC A13/MF A01 - GPO	TI85010580	MN -78	10:31020
4131	NTIS, PC A03/MF A01 - GPO	TI85901477	MN -41	10:32273
4134	NTIS, PC A06/MF A01 - GPO	TI85006789	MN -70	10:29952
4140	NTIS, PC A06/MF A01 - GPO	TI85013270	MN -78	10:31021
4147	NTIS, PC A05/MF A01 - GPO	TI85013268	MN -80	10:31554
4149	NTIS, PC A05/MF A01 - GPO	TI85012868	MN -78	10:30718
4159	NTIS, PC A09/MF A01 - GPO	TI85901493	MN -11	10:32114
4161-Vol.1	NTIS, PC A05/MF A01 - GPO	TI85012798	MN -70	10:29953
4168	NTIS, PC A12/MF A01 - GPO	TI85012551	MN -78	10:31022
4177-Vol.1	NTIS, PC A05/MF A01 - GPO	TI85901530	MN -80	10:31023
4177-Vol.2	NTIS, PC A04/MF A01 - GPO	TI85901531	MN -80	10:31024
4190	NTIS, PC A02/MF A01 - GPO	TI85901487	MN -41	10:29776
4192	NTIS, PC A04/MF A01 - GPO	TI85013274	MN -70	10:29954
4194	NTIS, PC A10/MF A01 - GPO	TI85901546	MN -70B	10:29955
4196	NTIS PC E07/MF $6.75 - GPO	TI85012991	MN -78	10:31025
4201	NTIS, PC A03/MF A01 - GPO	TI85012086	MN -70B	10:29956
4203	NTIS PC E05/MF A01 - GPO	TI85012601	MN -41	10:30031
4204	NTIS, PC A03/MF A01 - GPO	TI85011158	MN -78	10:30689
4205	NTIS, PC A04/MF A01 - GPO	TI85901543	MN -78	10:31026
4206	NTIS, PC A03/MF A01 - GPO	TI85011583	MN -80	10:30768
4215	NTIS, PC A04/MF A01 - GPO	TI85012785	MN -70B	10:29957
4221	NTIS, PC A05/MF A01 - GPO	TI85012540	MN -78	10:30690
4230	NTIS, PC A05/MF A01 - GPO	TI85013092	MN -80	10:31027
4231	NTIS, PC A04/MF A01 - GPO	TI85013093	MN -80	10:31028
4254	NTIS, PC A06/MF A01 - GPO	TI85013084	MN -41	10:31029
4262-Vol.1	NTIS, PC A05/MF A01 - GPO	TI85013358	MN -78	10:31030
4262-Vol.2	NTIS, PC A15/MF A01 - GPO	TI85013359	MN -78	10:31031
4263	NTIS, PC A05/MF A01 - GPO	TI85012990	MN -78	10:30814

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NYSERDA-				
85-6	New York State Energy Research and Development Authority, Two Rockefeller Plaza, Albany, NY 12223	TI85901501	MN -95d	10:31274
NYU/DAS-				
85-137	*See* DOE/EV/10610-4	E 1.99: DE85013326	MN -90i	10:32133
OCS/EIS/MMS-				
85-0032	Minerals Management Service, Vienna, VA 22180	TI85901498	MN -92	10:29787
OEFZS-				
4305	NTIS (US Sales Only), PC A04/MF A01	DE85701513	MN -70	10:29958
4306	NTIS (US Sales Only), PC A02/MF A01	DE85701481	MN -23	10:32061
4307	NTIS (US Sales Only), PC A02/MF A01	DE85701470	MN -48	10:32326
ONWI-				
471	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99: DE85012385	MN -70	10:29959
ORAU/IEA-				
85-3(M)	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE85013362	MN -97	10:31807
ORNL-				
6131	NTIS, PC A21/MF A01; 1 (GPO Dep.)	E 1.99: DE85013548	MN -13	10:31808
6134	NTIS, PC A05/MF A01 (GPO Dep.)	E 1.99: DE85013532	STD -95	10:31555
6135	*See* NUREG/CR-4106	TI85010580	MN -78	10:31020
6142	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99: DE85012059	MN -95d	10:31377
6154	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE85012056	STD -79h	10:30744
6162	NTIS, PC A07/MF A01 (GPO Dep.)	E 1.99: DE85013531	STD -90d	10:29616
6164	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE85011303	MN -41	10:32327
6173	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE85012076	MN -41	10:32828
ORNL/CON-				
122/ R1	NTIS, PC A99/MF A01 (GPO Dep.)	E 1.99: DE85013550	MN -95d	10:31275
ORNL/CSD-				
78/ R1	NTIS, PC A08/MF A01	DE85013103	STD -79d	10:30821
ORNL/CSD/TM-				
216	*See* NUREG/CR-3723	TI85006633	MN -78	10:30717
ORNL/NOAC-				
214	*See* NUREG/CR-3551	TI85012807	MN -80	10:31009
ORNL/NSIC-				
200-Vol.4-No.4	*See* NUREG/CR-2000-Vol.4-No.4	TI85012784	MN -78	10:31005
ORNL/NUREG/CSD-				
2/ Vol.1	*See* NUREG/CR-0200-Vol.1	TI85007563	MN -15	10:30780
2/ Vol.2	*See* NUREG/CR-0200-Vol.2	TI85007576	MN -15	10:30785
2/ Vol.3	*See* NUREG/CR-0200-Vol.3	TI85007581	MN -15	10:30796
ORNL/Sub-				
83/ 43374/ 1/ V3	NTIS, PC A07/MF A01; 1	DE85011301	STD -97	10:32105
84-00240/ 1	NTIS, PC A19/MF A01; 1 (GPO Dep.)	E 1.99: DE85013549	MN -95d	10:31276
84-95128/ 1	NTIS, PC A05/MF A01 (GPO Dep.)	E 1.99: DE85011923	MN -20a	10:33027
ORNL/TM-				
8664/ V2	*See* NUREG/CR-3514-Vol.2	TI85010139	MN -78	10:31693
8842	NTIS, PC A21/MF A01 - GPO	TI85010582	MN -78	10:31032
8938	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012066	STD -20	10:32912
9041/ V2	*See* NUREG/CR-3626-Vol.2	TI85008300	MN -80	10:30767
9067	*See* NUREG/CR-3651	TI85010620	MN -78	10:31010
9372	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85011302	STD -20f	10:32913
9381	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE85013365	STD -25	10:31546
9397	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99: DE85012082	STD -20	10:32914
9399	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE85012068	STD -20f	10:32915
9412	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99: DE85013519	STD -70	10:31576
9445	*See* NUREG/CR-4206	TI85011583	MN -80	10:30768
9477	*See* NUREG/CR-4086	TI85009806	MN -80	10:30688
9491	*See* NUREG/CR-4092	TI85011249	MN -78	10:31472
9501	NTIS, PC A05/MF A01 (GPO Dep.)	E 1.99: DE85013104	STD -20f	10:32502
9506	*See* NUREG/CR-4105	TI85010347	MN -78	10:31019
9509	NTIS, PC A08/MF A01	DE85012077	ND -97	10:31171
9522	*See* NUREG/CR-4134	TI85006789	MN -70	10:29952
9573	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE85012057	STD -79h	10:31473
9608	NTIS, PC A05/MF A01 (GPO Dep.)	E 1.99: DE85013543	MN -13	10:31347
9649	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE85013527	STD -4	10:31659
OSS/RR-				
3	NTIS (US Sales Only), PC A08/MF A01	DE85701052	MN -41	10:30013
OSS/TM-				
6	NTIS (US Sales Only), PC A02/MF A01	DE85701053	MN -41	10:30014
OUEL-R-				
1309/ 80	NTIS (US Sales Only), PC A02/MF A01	DE85701455	MN -25	10:31474
1492/ 83	NTIS (US Sales Only), PC A04/MF A01	DE85701456	MN -25	10:31475
PATENTS-US-	(US: Commissioner of Patents, Washington, D.C. 20231, USA, $1.00 per copy. Government Patent Applications available from NTIS)			
A 6-632,743		E 1.99: DE85011638	MN -78	10:30720
A 6-636,656		E 1.99: DE85011646	MN -4	10:31714
A 6-636,658		E 1.99: DE85011648	MN -4	10:31666
A 6-636,659		E 1.99: DE85011649	MN -80	10:30822
A 6-641,547		E 1.99: DE85011660	MN -83	10:29892
A 6-645-654		E 1.99: DE85011669	MN -79	10:30750
A 6-648,197		E 1.99: DE85011672	MN -41	10:32167
A 6-649,623		E 1.99: DE85011586	MN -22	10:29889
A 6-649,626		E 1.99: DE85011587	MN -86	10:29993
A 6-662,641		E 1.99: DE85011618	MN -21	10:33062

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A 6-662,642		E 1.99: DE85011619	MN -20	10:33063
A 6-662,645		E 1.99: DE85011620	MN -20a	10:33064
PB-				
85-153906/ XAB	NTIS, PC A04/MF A01			10:32142
85-155695/ XAB	NTIS, PC A06/MF A01			10:32190
85-155737/ XAB	NTIS PC E04/MF E04			10:31277
85-155943/ XAB	NTIS, PC A06/MF A01			10:32143
85-156008/ XAB	NTIS PC E03/MF E03			10:31278
85-156271/ XAB	NTIS, PC A03/MF A01			10:30659
85-156446/ XAB	NTIS, PC A99/MF A01			10:32201
85-156941/ XAB	NTIS PC E10/MF E01			10:31375
85-157337/ XAB	NTIS PC E04/MF E01			10:31279
85-157378/ XAB	NTIS, PC A02/MF A01			10:32144
85-157386/ XAB	NTIS, PC A02/MF A01			10:32145
85-157410/ XAB	NTIS, PC A11/MF A01			10:29851
85-157501/ XAB	NTIS PC E08/MF E08			10:30401
85-157527/ XAB	NTIS PC E05/MF E05			10:30630
85-157592/ XAB	NTIS, PC A05/MF A01			10:31822
85-157675/ XAB	NTIS, PC A04/MF A01			10:30655
85-157873/ XAB	NTIS PC E03/MF E03			10:31762
85-158277/ XAB	NTIS, PC A10/MF A01			10:31378
85-158616/ XAB	NTIS, PC A06/MF A01			10:31280
85-158897/ XAB	NTIS PC E10/MF E10			10:31362
85-158962/ XAB	NTIS PC E05/MF E05			10:31281
85-159838/ XAB	NTIS, PC A03/MF A01			10:31348
85-160067/ XAB	NTIS PC E07/MF E07			10:30294
85-165777/ XAB	NTIS, PC A04/MF A01			10:31363
85-167245/ XAB	NTIS, PC A05/MF A01			10:31376
85-167336/ XAB	Source tape is in the ASCII character set. This restricts preparation to 9 track, one-half inch tape only. Identify recording mode by specifying density only. Call NTIS Computer Products if you have questions			10:31282
85-168839/ XAB	NTIS PC E04/MF E01			10:30084
85-169126/ XAB	NTIS PC E04/MF E01			10:31283
85-169134/ XAB	NTIS PC E04/MF E01			10:31284
85-169159/ XAB	NTIS PC E04/MF E01			10:31115
85-169340/ XAB	NTIS PC E05/MF E01			10:31112
85-169605/ XAB	NTIS, PC A03/MF A01			10:32146
85-170421/ XAB	NTIS, PC A05/MF A01			10:31285
85-171452/ XAB	NTIS, PC A03/MF A01			10:31577
85-172203	Pub. in Proceedings of Annual Conference of the Microbeam Analysis Society (17th), Washington, DC., August 9-13, 1982, p219-221			10:32804
85-172336/ XAB	NTIS, PC A04/MF A01			10:32147
85-172393/ XAB	NTIS PC E04/MF E04			10:31830
85-172401/ XAB	NTIS PC E03/MF E03			10:31831
85-172575/ XAB	NTIS, PC A04/MF A01			10:31364
85-173086/ XAB	NTIS, PC A06/MF A01			10:30660
85-173276/ XAB	NTIS, PC A09			10:30661
85-173482/ XAB	NTIS, PC A09/MF A01			10:30662
85-173912/ XAB	NTIS, PC A06/MF A01			10:30663
85-174910/ XAB	NTIS, PC A04/MF A01			10:31365
85-175867/ XAB	NTIS, PC A12/MF A01			10:29676
85-175875/ XAB	NTIS, PC A08/MF A01			10:29677
85-175883/ XAB	NTIS, PC A16/MF A01			10:29678
85-175891/ XAB	NTIS, PC A06/MF A01			10:29679
85-175909/ XAB	NTIS, PC A12/MF A01			10:29680
85-175917/ XAB	NTIS, PC A06/MF A01			10:29681
85-175925/ XAB	NTIS, PC A07/MF A01			10:29682
85-175933/ XAB	NTIS, PC A14/MF A01			10:29683
85-176170/ XAB	NTIS, PC A06/MF A01			10:31832
85-177087/ XAB	NTIS, PC A14/MF A01			10:29812
85-177111/ XAB	NTIS, PC A06/MF A01			10:31366
85-177129/ XAB	NTIS, PC A04/MF A01			10:31367
85-178051/ XAB	NTIS, PC A03/MF A01			10:31430
85-180297/ XAB	NTIS, PC A08/MF A01			10:29783
85-180396/ XAB	NTIS, PC A11/MF A01			10:32380
85-180404/ XAB	NTIS, PC A18/MF A01			10:32381
85-180479/ XAB	NTIS, PC A08/MF A01			10:31286
85-183697/ XAB	NTIS, PC A02/MF A01			10:29806
85-183705/ XAB	NTIS, PC A05/MF A01			10:29775
85-184083/ XAB	NTIS, PC A07/MF A01			10:29807
85-185890/ XAB	NTIS, PC A12/MF A01			10:31368
PEL-				
284	NTIS (US Sales Only), PC A02/MF A01	DE85701484	MN -38	10:31747
PEL-R-				
819	NTIS (US Sales Only), PC A02/MF A01	DE85701472	MN -48	10:32236
PER-				
81	NTIS (US Sales Only), PC A04/MF A01	DE85780942	MN -51	10:32390
PNL-				
4742	*See* NUREG/CR-3317	TI85013318	MN -78	10:31008
4980-Exec.Summ.	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE85013177	MN -70B	10:30016
4980-Vol.1	NTIS, PC A09/MF A01 (GPO Dep.)	E 1.99: DE85013471	MN -70B	10:29961

Report Number	*Availability Source*	*File Number*	*Distribution Category*	*Abstract Number*
5064	*See* NUREG/CR-3747	TI85013799	MN -70A	10:29950
5106-4-Vol.4	*See* NUREG/CR-3810-Vol.4	TI85012832	MN -80	10:31011
5122	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99: DE85013030	MN -85	10:29899
5179	*See* NUREG/CR-3906	TI85013271	MN -70	10:29951
5354	*See* NUREG/CR-4168	TI85012551	MN -78	10:31022
5414	NTIS, PC A07/MF A01 (GPO Dep.)	E 1.99: DE85013581	MN -70	10:29962
5421	*See* NUREG/CR-4192	TI85013274	MN -70	10:29954
5434	NTIS, PC A05/MF A01 (GPO Dep.)	E 1.99: DE85013031	MN -11	10:32352
5462	NTIS, PC A08/MF A01; 1 (GPO Dep.)	E 1.99: DE85013167	MN -95	10:31191
5463	NTIS, PC A06/MF A01 (GPO Dep.)	E 1.99: DE85013032	MN -62	10:30349
5466	NTIS, PC A10/MF A01 (GPO Dep.)	E 1.99: DE85012249	MN -95f	10:31369
5483	NTIS, PC A06/MF A01 (GPO Dep.)	E 1.99: DE85013029	MN -63	10:30337
5486	NTIS, PC A05/MF A01 (GPO Dep.)	E 1.99: DE85013279	MN -70	10:29963
5501	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE85012537	MN -11	10:32172
5512	NTIS, PC A05/MF A01 (GPO Dep.)	E 1.99: DE85013806	MN -95	10:31370
PNL-SA-				
9230-Rev.	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012982	MN -48	10:32293
12565	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85010057	MN -70	10:29964
12625	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012455	MN -23	10:30053
12710	NTIS, PC A02/MF A01 - GPO	TI85012446	MN -15	10:30043
12829	NTIS, PC A02/MF A01 - GPO	TI85010966	MN -78	10:31033
12863	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85013042	MN -37	10:32062
12901	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85013278	MN -37	10:32033
12953	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012447	MN -70	10:29965
13023	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012456	MN -32	10:33099
PNL-tr-				
447	NTIS (US Sales Only), PC A08/MF A01; 1 (GPO Dep.)	E 1.99: DE85012910	MN -78	10:31038
PPPL-				
2209	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85011279	STD -20g	10:32916
2211	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85011739	STD -20g	10:32917
PPPL-Q-				
41	NTIS, PC A06/MF A01 (GPO Dep.)	E 1.99: DE85011971	STD -20	10:33028
PR-HS-				
11	*See* AECL-7684	DE85701526	MN -2	10:32010
12	*See* AECL-7777	DE85701527	MN -2	10:32011
15	*See* AECL-8105	DE85701530	MN -2	10:32012
16	*See* AECL-8266	DE85701531	MN -2	10:32817
PR-P-				
133	*See* AECL-7683	DE85701525	MN -2	10:33075
134	*See* AECL-7778	DE85701528	MN -2	10:32661
PT-U-				
83-0636	*See* AD-A-151737/4/XAB			10:32080
PUC-TN-				
01/ 83	NTIS (US Sales Only), PC A02/MF A01	DE85701442	MN -34D	10:32605
02/ 83	NTIS (US Sales Only), PC A02/MF A01	DE85701424	MN -34A	10:32834
03/ 83	NTIS (US Sales Only), PC A02/MF A01	DE85701425	MN -34A	10:32835
04/ 83	NTIS (US Sales Only), PC A03/MF A01	DE85701426	MN -34A	10:32836
05/ 83	NTIS (US Sales Only), PC A02/MF A01	DE85701427	MN -34A	10:32837
06/ 83	NTIS (US Sales Only), PC A02/MF A01	DE85701431	MN -34A	10:32805
07/ 83	NTIS (US Sales Only), PC A02/MF A01	DE85701428	MN -34A	10:32838
08/ 83	NTIS (US Sales Only), PC A03/MF A01	DE85701435	MN -34B	10:32447
09/ 83	NTIS (US Sales Only), PC A02/MF A01	DE85701412	MN -34A	10:32503
10/ 83	NTIS (US Sales Only), PC A02/MF A01	DE85701413	MN -34A	10:32504
11/ 83	NTIS (US Sales Only), PC A02/MF A01	DE85701429	MN -34A	10:31578
12/ 83	NTIS (US Sales Only), PC A02/MF A01	DE85701432	MN -34A	10:32806
13/ 83	NTIS (US Sales Only), PC A03/MF A01	DE85701430	MN -34A	10:31537
17/ 83	NTIS (US Sales Only), PC A02/MF A01	DE85701414	MN -34A	10:32505
18/ 83	NTIS (US Sales Only), PC A04/MF A01	DE85701404	MN -34D	10:32649
19/ 83	NTIS (US Sales Only), PC A02/MF A01	DE85701408	MN -34D	10:32624
20/ 83	NTIS (US Sales Only), PC A02/MF A01	DE85701466	MN -48	10:32214
21/ 83	NTIS (US Sales Only), PC A02/MF A01	DE85701405	MN -34D	10:32650
22/ 83	NTIS (US Sales Only), PC A02/MF A01	DE85701406	MN -34D	10:32651
23/ 83	NTIS (US Sales Only), PC A03/MF A01	DE85701407	MN -34D	10:32652
24/ 83	NTIS (US Sales Only), PC A03/MF A01	DE85701443	MN -34D	10:32606
25/ 83	NTIS (US Sales Only), PC A02/MF A01	DE85701394	MN -34C	10:32867
26/ 83	NTIS (US Sales Only), PC A02/MF A01	DE85701409	MN -34D	10:32625
27/ 83	NTIS (US Sales Only), PC A02/MF A01	DE85701395	MN -34C	10:32868
28/ 83	NTIS (US Sales Only), PC A03/MF A01	DE85701415	MN -34A	10:32506
29/ 83	NTIS (US Sales Only), PC A03/MF A01	DE85701446	MN -34D	10:32607
30/ 83	NTIS (US Sales Only), PC A02/MF A01	DE85701467	MN -48	10:32215
PWA-				
74/ 84	*See* KFK-3802	DE85751134	MN -25	10:31465
76/ 84	*See* KFK-3836	DE85751142	MN -86	10:29895
81/ 84	*See* KFK-3843	DE85751140	MN -86	10:32054
82/ 84	*See* KFK-3844	DE85751141	MN -86	10:32055
103/ 84	*See* KFK-3868	DE85751643	MN -86	10:31616
104/ 84	*See* KFK-3857	DE85751621	MN -38	10:31740
RAD-				
82-203-001-47-03	*See* PB-85-155695/XAB			10:32190
RAE-TR-				
84036	*See* N-85-17130			10:31104
RAL-				
84-049	NTIS (US Sales Only), PC A17/MF A01	DE85700996	MN -20	10:33029

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84-064	NTIS (US Sales Only), PC A02/MF A01		DE85700989	MN -34A	10:32807
84-077	NTIS (US Sales Only), PC A02/MF A01		DE85700990	MN -34A	10:32808
84-086	NTIS (US Sales Only), PC A02/MF A01		DE85700991	MN -20	10:32918
RAND/N-					
2049-DOE	NTIS, PC A09/MF A01 (GPO Dep.)	E 1.99:	DE85012399	MN -98B	10:29742
2295-DOE	NTIS, PC A06/MF A01 (GPO Dep.)	E 1.99:	DE85013273	MN -95c	10:31142
RAND/R-					
3040-RC	NTIS, PC A05/MF A01 (GPO Dep.)	E 1.99:	DE85012397	MN -91	10:29853
REG/G-					
2-85-Draft	US Nuclear Regulatory Commission, Washington, DC 20555		TI85901245	MN -41	10:32333
REPT-					
84	*See* PB-85-169126/XAB				10:31283
84-157	*See* N-85-18772				10:32907
84-702-110	*See* PB-85-176170/XAB				10:31832
100	*See* PB-85-169340/XAB				10:31112
102	*See* PB-85-169134/XAB				10:31284
106	*See* PB-85-169159/XAB				10:31115
139	*See* PB-85-168839/XAB				10:30084
85091	*See* N-85-19900				10:32440
RFP-					
3728	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE85004046	MN -25	10:31476
3746	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85012067	STD -70	10:29966
3780	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE85013394	STD -15	10:30044
RFP-Trans-					
438	NTIS (US Sales Only), PC A03; 3		DE85011580	MN -25	10:31508
RHO-BW-CR-					
143P	NTIS, PC A09/MF A01; 1 (GPO Dep.)	E 1.99:	DE85013315	MN -70	10:29967
RHO-BW-SA-					
217P	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99:	DE85011951	MN -70	10:29968
RHO-BW-ST-					
70P	NTIS, PC A05/MF A01 (GPO Dep.)	E 1.99:	DE85013499	MN -70	10:30017
RHO-RE-ST-					
31P	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE85011169	MN -25	10:31477
RI-					
176	NTIS (US Sales Only), PC A03/MF A01		DE85701048	MN -11	10:32200
RISO-M-					
2407	NTIS (US Sales Only), PC A04/MF A01; 1		DE85750794	MN -60	10:30631
2416	NTIS (US Sales Only), PC A10/MF A01; 1		DE85750795	MN -92a	10:29810
2435	NTIS (US Sales Only), PC A03/MF A01		DE85701233	MN -41	10:30018
2442	NTIS (US Sales Only), PC A03/MF A01		DE85701288	MN -2	10:31130
2449	NTIS (US Sales Only), PC A02/MF A01		DE85750796	MN -60	10:30617
RPC-E-					
83/ 47	NTIS (US Sales Only), PC A03/MF A01		DE85701496	MN -80	10:30731
RRC-					
53	NTIS (US Sales Only), PC A03/MF A01		DE85900954	MN -79b	10:30745
56	NTIS (US Sales Only), PC A04/MF A01; 1		DE85900957	MN -79	10:30746
57	NTIS (US Sales Only), PC A02/MF A01		DE85900958	MN -80	10:30807
58	NTIS (US Sales Only), PC A05/MF A01		DE85900959	MN -79	10:30808
61	NTIS (US Sales Only), PC A02/MF A01		DE85900951	MN -79	10:30747
63	NTIS (US Sales Only), PC A02/MF A01		DE85900997	MN -79h	10:30748
64	NTIS (US Sales Only), PC A06/MF A01; 1		DE85900952	MN -79d	10:30809
SAI-					
83/ 1055	*See* AD-A-152188/9/XAB				10:32103
SAIC-					
85/ 1676-PRI-91	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85012080	STD -20g	10:32919
SAND-					
80-8192-Vol.1	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE85013194	MN -62a	10:30350
80-8192-Vol.2	NTIS, PC A15/MF A01; 1		DE85013363	MN -62a	10:30351
82-1105	*See* NUREG/CR-2718		TI85012600	MN -78	10:31007
83-2269	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE85013231	MN -94a	10:31105
83-2334-Rev.	NTIS, PC A02/MF A01		DE85011804	MN -94ca	10:31106
83-6002(1-83)	NTIS, PC A07/MF A01; 3 (GPO Dep.)	E 1.99:	DE85005532	MN -20	10:30054
84-0159	NTIS, PC A05/MF A01 (GPO Dep.)	E 1.99:	DE85013178	MN -20d	10:33030
84-0637	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE85011866	MN -70	10:29969
84-0799	NTIS, PC A09/MF A01; 1 (GPO Dep.)	E 1.99:	DE85011144	MN -94cb	10:31107
84-0878	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99:	DE85013168	MN -70	10:31779
84-0996	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99:	DE85012245	MN -70	10:30019
84-1098	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE85013442	MN -94a	10:31108
84-1264	*See* NUREG/CR-3863		TI85012824	MN -78	10:30687
84-1461	*See* NUREG/CR-3904		TI85013272	MN -80	10:31013
84-1654	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE85013179	MN -21	10:33031
84-1795	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99:	DE85013033	MN -71	10:29900
84-1825C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85009982	MN -45	10:32092
84-1844C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE85009443	MN -45	10:32093
84-1860C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85011823	MN -45	10:32094
84-1957	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE85013171	MN -92	10:29802
84-2015	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99:	DE85013169	MN -70	10:29970
84-2043C	NTIS, PC A02/MF A01; 1 - GPO (GPO Dep.)	E 1.99:	TI85012354	MN -79p	10:31034
84-2065C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85004651	MN -34A	10:32507
84-2287C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE85011752	MN -25	10:31579
84-2374C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85012866	MN -38	10:31809
84-2392C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85012863	MN -28	10:31988
84-2395C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85012812	MN -28	10:31867

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84-2398C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012027	MN -28	10:31907
84-2412C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85012026	MN -28	10:31868
84-2421C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85011918	MN -28	10:31908
84-2434C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012867	MN -21	10:33032
84-2457C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012826	MN -28	10:31869
84-2458C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012356	MN -38	10:30667
84-2513C	NTIS, PC A02; 3	DE85012862	MN -38	10:31810
84-2519C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012860	MN -21	10:33033
84-2520C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012840	MN -21	10:33034
84-2523C	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE85013119	MN -21	10:33035
84-2530	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85013262	MN -63	10:30338
84-2537C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012841	MN -21	10:33036
84-2544C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85013438	MN -38	10:32063
84-2559C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012861	MN -21	10:33037
84-2560C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012809	MN -21	10:33038
84-2578C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012813	MN -38	10:31811
84-2638C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85013436	MN -38	10:31812
84-7139-6-84	*See* NUREG/CR-3855-6-84	TI85000657	MN -78	10:30813
84-8192	NTIS, PC A13/MF A01; 1 (GPO Dep.)	E 1.99: DE85012538	MN -62a	10:30352
85-0035C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012358	MN -28	10:31870
85-0039C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85011753	MN -28	10:31989
85-0045	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE85013170	MN -92	10:29803
85-0111	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE85013256	MN -34	10:32540
85-0132	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99: DE85013264	MN -38	10:31813
85-0173C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012355	MN -38	10:31748
85-0209	*See* NUREG/CR-4147	TI85013268	MN -80	10:31554
85-0385C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85009340	MN -23	10:32829
85-0391C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85008468	MN -34	10:33100
85-0548	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85013257	MN -37	10:32064
85-0551	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85011145	MN -11	10:32177
85-0564C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85009444	MN -23	10:32809
85-0632C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85008419	MN -34B	10:31814
85-0725C	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE85010122	MN -32	10:33101
85-0761C	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE85011726	MN -45	10:32095
85-0791/ 1	NTIS, PC A13/MF A01; 1 (GPO Dep.)	E 1.99: DE85013253	MN -63	10:30310
85-0807	NTIS, PC A05/MF A01 (GPO Dep.)	E 1.99: DE85012246	MN -70	10:29971
85-0841C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85009440	MN -38	10:32065
85-0856	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE85013260	MN -32	10:33102
85-0893	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99: DE85012247	MN -70	10:29972
85-0945C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85011544	MN -21	10:33039
85-0947	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE85013151	MN -13	10:31580
85-0990C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85011707	MN -11	10:29811
85-1110C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85011916	MN -32	10:33103
85-1133C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85011995	MN -28	10:31871
85-7161	NTIS, PC A05/MF A01 (GPO Dep.)	E 1.99: DE85011289	STD -71	10:29901
85-7166	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99: DE85012687	MN -70	10:32404
85-7194	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE85013152	MN -94cb	10:31109
85-8224	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99: DE85012536	MN -62a	10:30353
2305	*See* NUREG/CR-4044	TI85013275	MN -78	10:31016
SANL-				
126-016	*See* UCRL-15667	E 1.99: DE85012967	MN -70	10:29988
SD-TR-				
83-92	NTIS, PC A02/MF A01	DE85901412	MN -25	10:31763
84-50	NTIS, PC A03/MF A01; 1	DE85901411	MN -34B	10:32465
SERI/CP-				
211-2682	NTIS, PC A14/MF A01; 1 (GPO Dep.)	E 1.99: DE85008794	MN -63	10:30311
SERI/PR-				
212-2634	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE85008783	MN -63	10:30312
255-2493	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE85012131	MN -62	10:30551
SERI/STR-				
211-2607	NTIS, PC A03; 3	DE85008810	MN -63	10:30313
211-2675	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99: DE85008809	MN -63	10:30314
217-2584	NTIS, PC A05/MF A01 (GPO Dep.)	E 1.99: DE85008784	MN -60	10:30632
217-2629	NTIS, PC A11/MF A01; 1 (GPO Dep.)	E 1.99: DE85008806	STD -60	10:30633
SERI/TP-				
251-2648	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85002937	MN -95a	10:31295
253-2562	NTIS, PC A02/MF A01	DE85002945	MN -59A	10:30402
SERI/TR-				
215-2484	NTIS, PC A05/MF A01 (GPO Dep.)	E 1.99: DE85008807	MN -61C	10:30315
SGP-TR-				
77	NTIS, PC A06; 3	DE85009921	MN -66a	10:30607
78	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99: DE85009922	MN -66	10:30601
80	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99: DE85009923	MN -66a	10:30602
81	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99: DE85009924	MN -66a	10:30603
82	NTIS, PC A08/MF A01; 1 (GPO Dep.)	E 1.99: DE85009925	MN -66	10:29769
83	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE85009926	MN -66a	10:30604
SKBF-KBS-TR-				
79-11	NTIS (US Sales Only), PC A03/MF A01	DE85701227	MN -11	10:32405
79-15	NTIS (US Sales Only), PC A03/MF A01	DE85701280	MN -2	10:29973
79-21	NTIS (US Sales Only), PC A09/MF A01	DE85701245	MN -78	10:31035
79-28	NTIS (US Sales Only), PC A07/MF A01	DE85701267	MN -70	10:29974
80-04	NTIS (US Sales Only), PC A02/MF A01	DE85701268	MN -70	10:29896
80-24	NTIS (US Sales Only), PC A04/MF A01	DE85701269	MN -70	10:29975
82-19	NTIS (US Sales Only), PC A03/MF A01	DE85701270	MN -70	10:31547

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82-28	NTIS (US Sales Only), PC A04/MF A01	DE85701271	MN -70	10:29976
83-03	NTIS (US Sales Only), PC A03/MF A01	DE85701272	MN -70	10:29977
83-31	NTIS (US Sales Only), PC A03/MF A01	DE85701273	MN -70	10:29978
83-34	NTIS (US Sales Only), PC A03/MF A01	DE85701274	MN -70	10:32178
83-35	NTIS (US Sales Only), PC A04/MF A01	DE85701275	MN -70	10:29979
83-51	NTIS (US Sales Only), PC A03/MF A01	DE85701228	MN -11	10:32391
83-67	NTIS (US Sales Only), PC A05/MF A01	DE85780814	MN -70	10:29983
83-70	NTIS (US Sales Only), PC A04/MF A01	DE85701276	MN -70	10:29984
83-77	NTIS (US Sales Only), PC A11/MF A01	DE85701277	MN -70	10:29985
84-03	NTIS (US Sales Only), PC A02/MF A01	DE85701278	MN -70	10:29986
SKI-B-				
6-83	NTIS (US Sales Only), PC A08/MF A01	DE85701242	MN -80	10:31036
30-78	NTIS (US Sales Only), PC A02/MF A01	DE85701239	MN -25	10:31797
32-82	NTIS (US Sales Only), PC A02/MF A01	DE85701240	MN -80	10:31037
SLAC-PUB-				
3610	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85013063	MN -28	10:31990
3616	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85013062	MN -28	10:31991
3617	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85013378	MN -28	10:31872
3621	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85013061	MN -28	10:31909
3632	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85013058	MN -28	10:31992
3633	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85013057	MN -28	10:31993
3640	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85013375	MN -28	10:31910
3671	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85013074	MN -28	10:31994
3673	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85013073	MN -28	10:31911
3683	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85013070	MN -34D	10:32565
3689	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85013371	MN -28	10:31995
SLAC-TN-				
84-1-Rev.	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE85012389	MN -28	10:31996
SLU-ESO-TR-				
31-1983	NTIS (US Sales Only), PC A02/MF A01	DE85750841	MN -61	10:31635
SLU-LBT-				
126	*See* STEV-SB-83-26	DE85750866	MN -61A	10:30086
129	NTIS (US Sales Only), PC A06/MF A01; 1	DE85750870	MN -61D	10:30316
SMHI-MK-				
1984-7	*See* STEV-VIND-84-18	DE85750868	MN -60	10:30614
SMRE-Trans-				
6173	NTIS (US Sales Only), PC A03; 3	DE85901521	MN -88	10:29712
7253	NTIS (US Sales Only), PC A02; 3	DE85901522	MN -88	10:29710
7255	NTIS (US Sales Only), PC A02/MF A01; 1	DE85901524	MN -88	10:29711
SNV-PM-				
1713	NTIS (US Sales Only), PC A08; 3	DE85750842	MN -11	10:30085
SOL-				
85-1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85012381	MN -32	10:32880
85-5	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85013188	MN -32	10:33104
SOU-				
1983:19-Abst.	NTIS (US Sales Only), PC A04/MF A01	DE85750831	MN -13	10:31143
SPhT-				
84-122	*See* CEA-CONF-7431	DE85751555	MN -34C	10:32850
SRL-				
6569	*See* AD-A-151502/2/XAB			10:32536
SSI-A-				
84-01	NTIS (US Sales Only), PC A02/MF A01	DE85701237	MN -41	10:32165
84-04	NTIS (US Sales Only), PC A09/MF A01	DE85701279	MN -70	10:29987
STATSKONTORET-				
1984-21	NTIS (US Sales Only), PC A03/MF A01	DE85750859	MN -11	10:32169
STEV-BF-				
83-14	NTIS (US Sales Only), PC A04/MF A01; 1	DE85750843	MN -92b	10:29773
83-15	NTIS (US Sales Only), PC A09/MF A01; 1	DE85750840	MN -90c	10:29642
STEV-EO-				
83-13	NTIS (US Sales Only), PC A05/MF A01; 1	DE85750814	MN -61A	10:30317
84-4	NTIS (US Sales Only), PC A07/MF A01	DE85750839	MN -61A	10:30318
STEV-FBA-				
84-5	NTIS (US Sales Only), PC A04/MF A01	DE85750862	MN -90e	10:29726
STEV-SB-				
83-26	NTIS (US Sales Only), PC A06; 3	DE85750866	MN -61A	10:30086
83-36	NTIS (US Sales Only), PC A03/MF A01; 1	DE85750865	MN -61A	10:31749
84-1	NTIS (US Sales Only), PC A04/MF A01	DE85750845	MN -61A	10:30319
STEV-TFS-				
83-8	NTIS (US Sales Only), PC A04/MF A01	DE85750847	MN -60	10:30610
STEV-TORV-				
83-8	NTIS (US Sales Only), PC A03/MF A01	DE85750864	MN -88	10:29706
83-10	NTIS (US Sales Only), PC A02/MF A01	DE85750848	MN -90b	10:29643
84-3	NTIS (US Sales Only), PC A03/MF A01; 1	DE85750844	MN -88	10:29707
84-6	NTIS (US Sales Only), PC A06/MF A01; 1	DE85750863	MN -90a	10:29666
84-9	NTIS (US Sales Only), PC A04/MF A01; 1	DE85750867	MN -88	10:29708
STEV-VIND-				
83-25	NTIS (US Sales Only), PC A04/MF A01	DE85750815	MN -60	10:30634
84-3	NTIS (US Sales Only), PC A02/MF A01; 1	DE85750816	MN -60	10:30611
84-4	NTIS (US Sales Only), PC A03/MF A01	DE85750817	MN -60	10:30635
84-5	NTIS (US Sales Only), PC A02/MF A01	DE85750818	MN -60	10:30612
84-6	NTIS (US Sales Only), PC A02/MF A01; 1	DE85750819	MN -60	10:30613
84-7	NTIS (US Sales Only), PC A03/MF A01; 1	DE85750820	MN -60	10:30636
84-8	NTIS (US Sales Only), PC A02/MF A01; 1	DE85750821	MN -60	10:30637
84-9	NTIS (US Sales Only), PC A02/MF A01; 1	DE85750822	MN -60	10:30638

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84-10	NTIS (US Sales Only), PC A05/MF A01; 1	DE85750823	MN -60	10:30639
84-11	NTIS (US Sales Only), PC A03/MF A01; 1	DE85750824	MN -60	10:30640
84-12	Statens Energiverk, Stockholm, Sweden	TI85750825	ND -60	10:30641
84-13	NTIS (US Sales Only), PC A03/MF A01	DE85750826	MN -60	10:30642
84-18	NTIS (US Sales Only), PC A03/MF A01; 1	DE85750868	MN -60	10:30614
STU-				
80-5503	*See* SLU-LBT-129	DE85750870	MN -61D	10:30316
STUDSVIK-K-				
1-4-80-12	*See* SKBF-KBS-TR-80-04	DE85701268	MN -70	10:29896
STUDSVIK-NR-				
83-248	*See* SKI-B-32-82	DE85701240	MN -80	10:31037
STUDSVIK-SD-				
83-11	*See* SKI-B-32-82	DE85701240	MN -80	10:31037
T-				
6357/ BG/ WH782/ 84	*See* N-85-16319			10:32140
TC-SR-				
3	*See* IAEA-TC-427/5	DE85781016	MN -78	10:30681
TNO-HMT-R-				
84-76	Nijverheidsorganisatie TNO, Delt (Netherlands). Hoofdgroep Maatschappelijke Technologie			10:29684
TNO-MT-				
83M-013687-RAD-SGE	Nijverheidsorganisatie TNO, Apeldoorn (Netherlands). Metaalinstituut			10:29727
TP-				
82-36	NTIS (US Sales Only), PC A02/MF A01	DE85701494	MN -78	10:30719
TR-				
08-84	*See* AD-A-152095/6/XAB			10:33081
TRW-SN-				
39146	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85011795	MN -90i	10:32034
TTC-				
0506	*See* SAND-84-1795	E 1.99: DE85013033	MN -71	10:29900
UCAR-				
10062-83/ 1	NTIS, PC A12/MF A01; 1 (GPO Dep.)	E 1.99: DE85012398	MN -4	10:31713
UCID-				
20047	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE85012775	MN -37	10:32066
20092-Vol.1	*See* NUREG/CR-4161-Vol.1	TI85012798	MN -70	10:29953
20153	NTIS, PC A10/MF A01; 1 (GPO Dep.)	E 1.99: DE85012833	MN -20	10:33040
20172	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE85003996	MN -70	10:31491
20351	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99: DE85013036	MN -70	10:32406
20381	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85013176	MN -11	10:32110
20385	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012817	MN -96	10:31723
20400	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85013182	MN -20	10:32920
20405	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99: DE85011870	MN -20g	10:32921
20413-Vol.2	NTIS, PC A16/MF A01; 1 (GPO Dep.)	E 1.99: DE85011842	MN -80	10:30833
20415	NTIS, PC A08/MF A01; 1 (GPO Dep.)	E 1.99: DE85012952	MN -11	10:32115
20421-Vol.1	NTIS, PC A99/MF A01 - GPO (GPO Dep.)	E 1.99: TI85013208	MN -11	10:32398
20421-Vol.2	NTIS, PC A16/MF A01 - GPO (GPO Dep.)	E 1.99: TI85013209	MN -11	10:32399
20422	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012819	MN -32	10:33105
20423	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE85013364	MN -2	10:32106
UCLA/PPG-				
860	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012074	STD -20a	10:33041
UCRL-				
15475	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99: DE85012931	MN -11	10:32116
15475-Suppl.1	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE85012876	MN -11	10:32148
15475-Suppl.2	NTIS, PC A09/MF A01; 1 (GPO Dep.)	E 1.99: DE85012875	MN -11	10:32117
15561-Vol.3	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012956	MN -34	10:31764
15627	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99: DE85012962	MN -38	10:31765
15659	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012968	MN -37	10:31766
15660	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE85012958	MN -28	10:31912
15661	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85012978	MN -25	10:31750
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